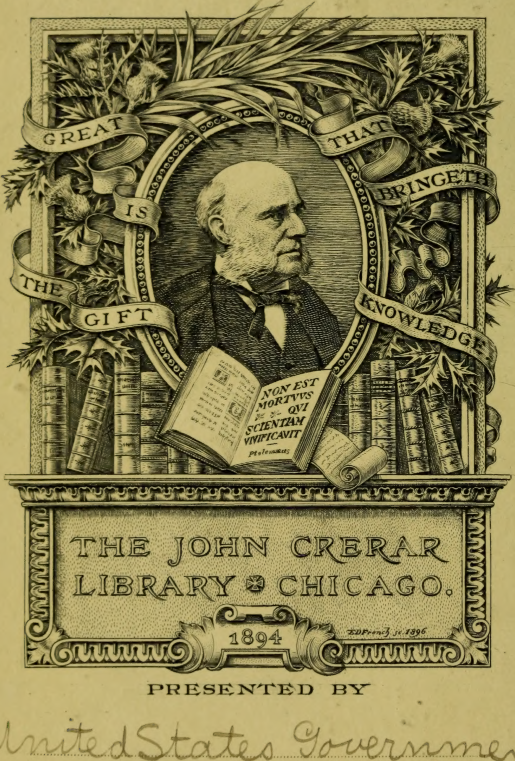
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VOLUME XIV NUMBER 22

# Ohio State University Bulletin

## College of Engineering

### Part I

April 7, 1910

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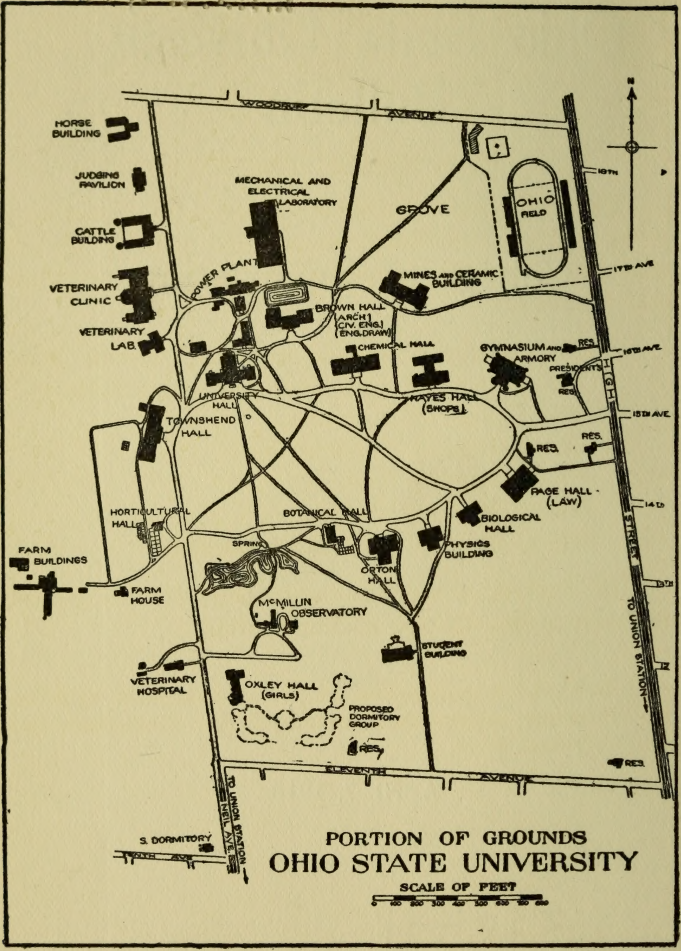

PORTION OF GROUNDS

OHIO STATE UNIVERSITY

## OHIO STATE UNIVERSITY

The Ohio State University, located in Columbus two miles north of the Union Station, is a part of the public educational facilities maintained by the State. It comprises seven colleges:

The College of Agriculture and Domestic Science,
The College of Arts, Philosophy, and Science,
The College of Education,
The College of Engineering,
The College of Law,
The College of Pharmacy,
The College of Veterinary Medicine.

This bulletin of announcements is devoted exclusively to the work of the College of Engineering.

(Note—In requesting any of the announcement bulletins of the University, address the University Editor, Ohio State University, Columbus, Ohio.)

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# UNIVERSITY CALENDAR

## 1910

Entrance examinations (8 a. m.), Tuesday to Saturday, June 14 to 18.

Summer Term, June 20 to August 12.

Entrance examinations (8 a. m.), Tuesday to Saturday, September 6 to 10.

First semester begins—Registration Day—Tuesday, Sepber 13.

President's Annual Address (11 a. m.), Friday, September 16.

Latest date of admission to candidacy for a degree at the Commencement of June, 1911, Saturday, October 1.

Date for mid-semester reports to the Deans concerning delinquent students, Saturday, November 19.

Thanksgiving recess, November 24, 25 and 26.

Christmas recess begins Wednesday, December 21.

## 1911

Christmas recess ends Tuesday, January 3.

First semester ends Friday, February 3.

Second semester begins—Registration Day—Monday, February 6.

Washington's Birthday, Wednesday, February 22.

Date for mid-semester reports to the Deans concerning delinquent students, Saturday, April 1.

Competitive Drill—Cadet Regiment—Saturday, May 27.

Memorial Day, Tuesday, May 30.

Final examinations, Friday to Thursday, June 2 to 8.

Entrance examinations (8 a. m.) Tuesday to Saturday, June 6 to 10.

Commencement, Wednesday, June 14.

# COLLEGE OF ENGINEERING

## COURSES OFFERED

This college offers instruction in eight important fields of engineering work. Covering these the following four-year courses of study are offered:

1. Architecture, leading to the degree of Civil Engineer in Architecture (C. E. in Arch.).

2. Ceramic Engineering, leading to the degree of Ceramic Engineer (Cer. E.).

3. Chemical Engineering, leading to the degree of Bachelor of Science in Chemical Engineering (B. Sc.).

4. Civil Engineering, leading to the degree of Civil Engineer (C. E.).

5. Electrical Engineering, leading to the degree of Mechanical Engineer in Electrical Engineering (M. E. in E. E.).

6. Industrial Arts, leading to the degree of Bachelor of Science in Industrial Arts (B. Sc.).

7. Mechanical Engineering, leading to the degree of Mechanical Engineer (M. E.).

8. Mine Engineering, leading to the degree of Engineer of Mines (E. M.).

The following two-year, or short courses, do not lead to a degree, but students completing them are furnished a formal certificate stating the work they have accomplished:

9. Clay-working.
10. Industrial Arts and Shopwork.
11. Mining.

## FACULTY AND INSTRUCTORS

WILLIAM OXLEY THOMPSON, D. D., LL. D., PRESIDENT OF THE UNIVERSITY.

SIDNEY AUGUSTUS NORTON, Ph. D., LL. D., Emeritus Professor and Lecturer in Chemistry.

STILLMAN W. ROBINSON, C. E., D. Sc., Emeritus Professor of Mechanical Engineering.

ROBERT WHITE McFARLAND, LL. D., Emeritus Professor of Civil Engineering.

FRANCIS CARY CALDWELL, B. A., M. E., ACTING DEAN, Professor of Electrical Engineering.

EDWIN F. CODDINGTON, C. E., Ph. D., SECRETARY, and Associate Professor of Mechanics.

NATHANIEL WRIGHT LORD, E. M., Professor of Metallurgy and Mineralogy and Director of the School of Mines.

*EDWARD ORTON, JR., E. M., Professor of Ceramic Engineering and Director of the Department.

BENJAMIN FRANKLIN THOMAS, Ph. D., Professor of Physics.

ROSSER DANIEL BOHANNAN, B. Sc., C. E., E. M., Professor of Mathematics.

BENJAMIN LESTER BOWEN, Ph. D., Professor of Romance Languages and Literatures.

JOSEPH VILLIERS DENNEY, B. A., Professor of English.

WILLIAM THOMAS MAGRUDER, M. E., Professor of Mechanical Engineering.

WILLIAM McPHERSON, JR., D. Sc., Ph. D., Professor of Chemistry.

JOSEPH NELSON BRADFORD, M. E., Professor of Architecture.

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*Absent on leave, 1909-1910.

FRANK EDWIN SANBORN, S. B., Professor of Industrial Arts and Director of the Department.

FRANK ARNOLD RAY, E. M., Professor of Mine Engineering.

HENRY CURWEN LORD, B. Sc., F. R. A. S., Professor of Astronomy and Director of the Emerson McMillin Observatory.

EMBURY ASBURY HITCHCOCK, M. E., Professor of Experimental Engineering.

CHARLES SMITH PROSSER, Ph. D., Professor of Geology.

CHRISTOPHER ELIAS SHERMAN, C. E., Professor of Civil Engineering.

LEWIS ADDISON RHOADES, Ph. D., Professor of Germanic Languages and Literatures.

FRANK HARVEY ENO, B. Sc., C. E., Professor of Municipal Engineering.

JAMES ELLSWORTH BOYD, M. S., Professor of Mechanics.

THOMAS EWING FRENCH, M. E., Professor of Engineering Drawing.

GEORGE WASHINGTON MCCOARD, M. A., Professor of Mathematics.

*WILLIAM EDWARDS HENDERSON, Ph. D., Professor of Inorganic and Physical Chemistry.

CHARLES A. BRUCE, B. A., Professor of the Romance Languages.

CHARLES WILLIAM FOULK, B. A., Professor of Analytical Chemistry.

MATTHEW BROWN HAMMOND, Ph. D., Professor of Economics and Sociology.

CLYDE T. MORRIS, C. E., Professor of Structural Engineering.

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*Absent on leave, 1909-1910.

KARL DALE SWARTZEL, M. Sc., Professor of Mathematics.

HARRY WALDO KUHN, Ph. D., Professor of Mathematics.

EDWARD ELSWORTH SOMERMEIER, G. Ph., Associate Professor of Metallurgy and Mineralogy.

CHARLES LINCOLN ARNOLD, M. Sc., Associate Professor of Mathematics.

WILLIAM LLOYD EVANS, Ph. D., Associate Professor of Chemistry.

*BERTHOLD AUGUST EISENLOHR, M. A., Associate Professor of the Germanic Languages and Literatures.

SAMUEL EUGENE RASOR, B. Sc., Associate Professor of Mathematics.

JOHN HERMAN HUNT, B. S. in E. E., Associate Professor in Electrical Engineering.

ROSS C. PURDY, Cer. E., Associate Professor of Ceramic Engineering.

CHARLES ST. JOHN CHUBB, Jr. C. E. (Arch.), Associate Professor of Architecture.

ROBERT F. EARHART, Ph. D., Associate Professor of Physics.

WILLIAM ABNER KNIGHT, M. E., Associate Professor of Machine-Shop Practice.

HORACE JUDD, M. E., M. Sc., Associate Professor of Experimental Engineering.

JAMES RENWICK WITHROW, Ph. D., Associate Professor of Chemistry.

EDMUND SEWALL MANSON, JR., M. S., Associate Professor of Astronomy.

CARSON SAMUEL DUNCAN, M. S., Assistant Professor of English.

ROY K. SCHLAFLY, C. E., Assistant Professor of Civil Engineering.

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*Absent on leave, 1909-1910.

THOMAS KENYON LEWIS, B. Sc., Assistant Professor of Engineering Drawing.

ROBERT MEIKELJOHN, M. E., Assistant Professor of Engineering Drawing.

OLIVER C. LOCKHART, M. A., Assistant Professor of Economics and Sociology.

WALTER LYMAN UPSON, M. E. E., Assistant Professor of Electrical Engineering.

DANA J. DEMOREST, B. Sc. (Chem. Eng.), Assistant Professor of Metallurgy and Mineralogy.

CHARLES C. MORRIS, M. A., Assistant Professor of Mathematics.

ADOLPH BUSSE, Ph. D., Assistant Professor of the Germanic Languages and Literatures.

JOHN ROSS CHAMBERLAIN, Assistant Professor of Civil Engineering.

HOMER F. STALEY, Cer. E., Assistant Professor of Ceramic Engineering.

ALPHEUS WILSON SMITH, Ph. D., Assistant Professor of Physics.

CHARLES SHEARD, M. A., Assistant Professor of Physics.

WELLS H. MINOR, E. M., Assistant Professor of Mine Engineering.

HORACE NELSON PACKARD, M. E., Assistant Professor of Experimental Engineering.

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OLIVE JONES, B. A., Librarian.

GEORGE L. CONVERSE, Captain U. S. A. (Retired), Professor of Military Science and Tactics.

H. SHINDLE WINGERT, M. D., Professor of Physical Education.

JOHN ADAMS BOWNOCKER, D. Sc., Professor of Inorganic Geology and Curator of the Museum.

JAMES EDWARD HAGERTY, Ph. D., Professor of Economics and Sociology.

WILLIAM LUCIUS GRAVES, M. A., Associate Professor of English.

EDGAR S. INGRAHAM, Ph. D., Associate Professor of Romance Languages.

FAYETTE AVERY McKENZIE, Ph. D., Associate Professor of Economics and Sociology.

GEORGE D. HUBBARD, Ph. D., Assistant Professor of Geology.

MAY THOMAS, Ph. D., Assistant Professor in German.

CHARLES PHILIP CROWE, Instructor in Forging.

JOHN SATTERLEE TIDBALL, B. S., Instructor in Engineering Drawing.

W. J. NORRIS, Instructor in Engineering Drawing.

ALLANDO CASE, Instructor in Vise Work.

CLEMENT M. BEEM, Instructor in Patternmaking and Founding.

F. H. HASKETT, Instructor in Architecture.

WILLIAM CLIFFORD MORSE, M. A., Instructor in Geology.

A. C. HARPER, Instructor in Engineering Drawing.

OWEN E. WILLIAMS, Instructor in Engineering Drawing.

CREE SHEETS, C. E. (Arch.), Instructor in Engineering Drawing.

WESLEY GARNET WORCESTER, Instructor in Ceramic Engineering.

KENNETH BAKER WARD, C. E., Assistant in Civil Engineering.

ULYSSES W. DENMAN, Assistant in Patternmaking.

ALFRED HENRY BARNES, M. E. in E. E., M. A., Assistant in Physics.

ALBERT HARRISON HINKLE, C. E., Assistant in Civil Engineering.

John Ernest Shepardson, B. S., Assistant in Electrical Engineering.

Christian Nusbaum, B. A., Assistant in Physics.

Alexander Vallance, Student Assistant in Mechanical Engineering.

Dennis R. Born, Student Assistant in Mechanics.

J. Thomas Kibler, Assistant in Physical Education.

## FELLOW

Cyrus Alan Melick, C. E., Robinson Fellow in Engineering.

# ADMISSION

Applicants for admission must be at least seventeen years of age. The College is open on equal terms to both sexes.

## UNIVERSITY ENTRANCE BOARD

The admission of students is in charge of the University Entrance Board, which determines the credits which shall be issued on all entrance examinations and certificates, and furnishes all desired information to applicants. Correspondence relating to admission should be addressed to the Entrance Board, Ohio State University, Columbus.

## ADMISSION TO THE COURSE LEADING TO A DEGREE

There are two modes of admission to the course leading to a degree: (a) by examination, (b) by certificate.

## ADMISSION BY EXAMINATION

The Entrance Board will conduct entrance examinations June 14 to 18 and September 6 to 10, 1910. A part of the examinations may be taken in June and the remainder in September. All applicants for admission who are not graduates of an accredited or recognized secondary school or approved preparatory school, or who do not possess certificates from the State Board of School Examiners, must take examinations for admission.

Schedule—Examinations will be from 8 to 12 a. m. and from 1 to 5 p. m.

| | | |
|---|---|---|
| Tuesday, | A. M. | History: Greek and Roman, English, General. |
| Tuesday, | P. M. | Composition and Rhetoric, Classics, Chemistry, Geology. |
| Wednesday, | A. M. | Algebra, German, English Grammar, Descriptive Geography. |
| Wednesday, | P. M. | Plane Geometry, Physical Geography, Arithmetic. |
| Thursday, | A. M. | Civics, Solid Geometry, Zoology. |

| | | |
|---|---|---|
| Thursday, | P. M. | Beginning Latin, Cæsar, Astronomy, Elements of Agriculture. |
| Friday, | A. M. | Physics, Physiology, Botany. |
| Friday, | P. M. | U. S. History, French, English Literature. |
| Saturday, | A. M. | Vergil, Cicero. |

## ADMISSION BY CERTIFICATE

Applicants may be admitted without examination on presentation of properly indorsed certificates from such secondary schools as have been accredited* or recognized by the University, or from approved normal schools, or from the State Board of School Examiners under the following provisions:

(a) If from secondary schools, the certificate must show that the applicant is a graduate in good standing of the school issuing it; and also must state in detail the studies pursued, the text-books used, the amount of work done in each study, the amount of time devoted to it, and the fact that the applicant has passed in the work.

(b) Any entrance requirement not covered by a certificate must be met by examination.

Blank certificates may be obtained by addressing the Secretary of the Entrance Board. Certificates should be filled out and returned by the proper official to the University as early as possible after the close of schools in June.

## REQUIREMENTS BY UNITS

A unit is the equivalent of a course of study covering a school year of not less than thirty-six weeks, with five periods of at least forty-five minutes each per week. To obtain full standing, applicants under twenty-one years of age must have credit by examination or certificate for fifteen units—of which three shall be English, one history, three mathematics (including solid Geometry), one physics, and four language other than English—selected from the following list:

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* For information regarding these schools consult the bulletin on Entrance Information, which will be sent on request.

| | |
|---|---|
| English | 3 units |

(Foreign students may substitute their native language for the English requirement.)

| | |
|---|---|
| American History or American History and Civil Government | 1 unit |
| Ancient History (Greek and Roman) and Mediaeval History to 814 A. D. | 1 unit |
| Mediaeval and Modern History (from 814 A. D. to the present) | 1 unit |

(For the present General History may be counted as a unit, but not in addition to Ancient or Mediaeval and Modern History.)

| | |
|---|---|
| English History | 1 unit |
| Algebra (through quadratics) | 1 unit |
| Algebra (beyond quadratics) | ½ unit |
| Geometry (plane) | 1 unit |
| Geometry (solid) | ½ unit |
| Trigonometry | ½ unit |
| Latin | 2, 3, or 4 units |
| Greek | 2, 3, or 4 units |
| German | 2, 3, or 4 units |
| French | 2, 3, or 4 units |
| Spanish | 2, 3, or 4 units |

(Not less than two units of any language will be accepted.)

| | |
|---|---|
| Physics | 1 unit |
| Chemistry | 1 unit |
| Physical Geography | 1 unit |
| Zoology | 1 unit |
| Botany | 1 unit |
| Physical Geography<br>Zoology<br>Botany<br>Physiology | For the present any two of these may be counted together as 1 unit |
| Agriculture<br>Free-hand Drawing*<br>Manual Training<br>Domestic Science | The Entrance Board may, after investigating each claim, grant a total credit of not to exceed 2 units |

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* Students expecting to enter the College of Engineering are advised to take free-hand drawing in the high school.

Preparation in excess of the requirement in any subject will not be credited unless it amounts to one-half unit.

No student under twenty-one years of age will be admitted to college if he is conditioned in more than two of the fifteen units. All entrance conditions must be removed within two years after admission.

An applicant twenty-one years of age or over, who is deficient in foreign language training, will be admitted with a total deficiency of four units, provided at least two of the four are in the foreign language group.

Students over twenty-one years of age are admitted in accordance with the provisions stated under "Admission to Special Studies," page 16.

The extent and character of the work required in each subject mentioned above is explained in a special bulletin which will be sent to any address upon request by the University Editor. In general it may be stated that the definitions of the North Central Association of College and Secondary Schools are accepted as our definitions.

## ADMISSION WITH ADVANCED STANDING

Applicants who have completed at least one year's work in an approved college, and who bring official and explicit certificates describing their courses of study and scholarship, and letters of honorable dismissal, will be admitted in accordance with either of two plans:

(1) The entrance units on which the candidate was admitted to the approved college will be accepted at their face value; deficiencies will be made up from the college credits presented, and advanced credit will be given for any remaining satisfactory work; or

(2) One year's work will be accepted in lieu of entrance units and the candidate will be admitted without examination and without conditions, but without any advanced standing on the year's work.

Applicants who have completed less than one year's work in an approved college must satisfy the entrance requirements in the usual way, and will then be given credit for any satisfactory work for which they can offer certificates.

## ADMISSION TO SPECIAL STUDIES

Students who desire to pursue special lines of work in the University, and do not intend to become candidates for degrees, will be admitted on the following conditions:

1. If the applicant can satisfy the entrance requirements, he should send to the Entrance Board for reference to the Executive Committee of the Engineering College a complete statement of the course which he wishes to take, together with his reasons for desiring this course, and a detailed statement of his practical experience in Engineering.

2. If he cannot satisfy the entrance requirements, but is at least twenty-one years of age, he *may* be admitted by the joint action of the Entrance Board and the Executive Committee of the Engineering College, provided he passes the entrance examinations in Algebra and Plane Geometry. Such a student must send a full statement of the course he wishes to pursue, his practical experience in Engineering, and certificates from his employers giving the nature and duration of this experience.

3. Permission to enter as special undergraduates will be refused to all who fail to give satisfactory evidence of definiteness of purpose and will be withdrawn whenever the conditions on which it was granted cease to exist.

## ADMISSION TO THE SHORT COURSES

Applicants must be at least seventeen years of age, and, unless they are over twenty-one years of age, must pass examinations in Arithmetic and Geography, and must be able to write a business letter or a short theme, correct in grammar and orthography; or they must present satisfactory certificates showing that they have successfully pursued these subjects elsewhere. In addition, each applicant under twenty-one years of age must present a letter or certificate showing that he has had at least one year's practical experience in some industry related to the course which he wishes to pursue.

Applicants over twenty-one years of age are admitted without examination, and without letter or certificate of practical experience.

## REMOVAL OF ENTRANCE CONDITIONS

The removal of entrance conditions is administered by the Entrance Board. Conditions may be removed (1) by examination (for schedule of examinations see page 11); or (2) by the substitution of excess work in other approved subjects, or (3) by the substitution of other equivalent work to be done at the University. The Secretary of the College will assign to each student having entrance conditions outstanding at the end of the Freshman year such college courses as may be deemed a fair equivalent for the work in which the student has entrance conditions. A condition in physics must be removed before entering on the work of the second year.

# COURSES OF STUDY

## OUTLINE OF THE FIRST YEAR'S WORK OF ALL FOUR-YEAR COURSES

NOTE—The figure in parenthesis following the name of each study indicates the number of the study in its department; the other figure indicates the number of credit hours.

| FIRST SEMESTER | | | SECOND SEMESTER | | |
|---|---|---|---|---|---|
| Mathematics<br>College Algebra and Trig. | (131) | 5. | Mathematics<br>Trig. and Analytics. | (132) | 5. |
| Chemistry<br>General Chemistry. | (105 or 109) | 4. | Chemistry<br>General Chemistry and Qualitative Analysis. | (106 or 110) | 4. |
| Modern Language<br>Fren., Ger., or Span. | | 4. | Modern Language<br>Fren., Ger., or Span. | | 4. |
| English<br>Paragraph Writing. | (101) | 2. | English<br>Paragraph Writing. | (104) | 2. |
| Engineering Drawing<br>Elementary Mechanical. | (101) | 2. | Engineering Drawing<br>Lettering and Projections. | (102) | 3. |
| Military Drill | | 1. | Military Drill | | 1. |
| Gymnasium | | 1. | Gymnasium | | 1. |

Students presenting Chemistry as an entrance subject will take Chemistry 109 and 110. Students with no entrance credits in Chemistry will take Chemistry 105 and 106.

SUMMER SESSION—Students electing courses named below are required to take courses in the summer session as follows:

ARCHITECTURE—Engineering Drawing (107) and Art (103) at the close of the first year.

CERAMIC ENGINEERING—Two from Shopwork (107), (109) and (115), at the close of the first year.

CHEMICAL ENGINEERING—Shopwork (109) and (115) at the close of the first or second year.

ELECTRICAL ENGINEERING, MECHANICAL ENGINEERING AND MINE ENGINEERING—Shopwork (109) and (115) at the close of the first year.

INDUSTRIAL ARTS—Shopwork (107) and (109) at the close of the first year.

# COURSE IN ARCHITECTURE

FOR FIRST YEAR SEE PAGE 18

Summer Session—Students are required to take Engineering Drawing (107), Descriptive Geometry, and Art (103), Charcoal Drawing, during the Summer Session at the close of the first year.

## SECOND YEAR

| First Semester | | | Second Semester | | |
|---|---|---|---|---|---|
| Mathematics<br>Calculus. | (141) | 5. | Mathematics<br>Calculus. | (142) | 5. |
| Engineering Drawing<br>Charcoal from Ornament. | (115) | 2. | Engineering Drawing<br>Pen Drawing. | (116) | 2. |
| Architecture<br>History of Architecture. | (101) | 3. | Architecture<br>Hist. of Arch. | (102) | 3. |
| Architecture<br>Order Problems. | (103) | 2. | Architecture<br>Order Problems. | (104) | 5. |
| Architecture<br>Shades, Shadows, and Perspective. | (105) | 3. | Architecture<br>Stereotomy. | (106) | 3. |
| Physics<br>General Physics. | (111) | 3. | | | |
| Military Drill | | 1. | Military Drill | | 1. |

Summer Course—Architecture (120), Architectural Practice, or an Architectural Problem.

## THIRD YEAR

| | | | | | |
|---|---|---|---|---|---|
| Mechanics<br>Statics and Str. of Mater'ls. | (101) | 5. | Mechanics<br>Strength of Materials. | (104) | 2. |
| Engineering Drawing<br>Water Color. | (117) | 3. | Engineering Drawing<br>Charcoal from Antique. | (118) | 3. |
| Architecture<br>Arch. Design. | (107) | 5. | Architecture<br>Arch. Design. | (108) | 4. |
| Architecture<br>Decoration, etc. | (109) | 3. | Architecture<br>Working Drawings. | (110) | 4. |
| Architecture<br>Arch. Composition. | (113) | 2. | Architecture<br>Photography. | (112) | 2. |
| | | | Civil Engineering<br>Trusses. | (124) | 3. |

## FOURTH YEAR

| | | | | | |
|---|---|---|---|---|---|
| Architecture<br>Arch. Design. | (115) | 6. | Architecture<br>Arch. Design. | (114) | 3. |
| Architecture<br>Plumbing. | (117) | 1. | Architecture<br>Professional Practice. | (116) | 4. |
| Architecture<br>Masonry. | (119) | 2. | Civil Engineering<br>Surveying. | (128) | 2. |
| Civil Engineering<br>Tall Buildings. | (125) | 3. | Civil Engineering<br>Cement and Concrete. | (118) | 3. |
| Mechanical Eng.<br>Materials of Const. | (123) | 2. | Architecture<br>Thesis. | (118) | 5. |
| Mechanical Eng.<br>Heating and Ventilating. | (121) | 2. | | | |
| Engineering Drawing<br>Clay Modeling. | (119) | 2. | | | |

# COURSE IN CERAMIC ENGINEERING

FOR FIRST YEAR SEE PAGE 18

SUMMER SESSION—Students are required to take two of the folfowing courses during the summer session at the close of the first year: Shopwork (107) Chipping and Filing, Shopwork (109) Joinery and Patternmaking, Shopwork (115) Forging.

## SECOND YEAR

| FIRST SEMESTER | | | SECOND SEMESTER | | |
|---|---|---|---|---|---|
| Mathematics<br>Calculus. | (141) | 5. | Mathematics<br>Calculus. | (142) | 5. |
| Physics<br>Mechanics and Heat. | (113) | 5. | Physics<br>Elec., Light and Sound. | (114) | 5. |
| Engineering Drawing<br>Desc. Geom. | (103) | 3. | Engineering Drawing<br>Machine Sketching. | (104) | 3. |
| Ceramic Engineering<br>Ceramic Chemistry. | (101) | 5. | Ceramic Engineering<br>Ceramic Calculations. | (106) | 2. |
| | | | Ceramic Engineering<br>Laboratory. | (102) | 3. |
| Military Drill | | 1. | Military Drill | | 1. |

## THIRD YEAR

| | | | | | |
|---|---|---|---|---|---|
| Mechanics<br>Statics and Str. of Mater'ls. | (101) | 5. | Mechanics<br>Strength of Materials. | (104) | 2. |
| Chemistry<br>Physical Chemistry. | (157) | 3. | Chemistry<br>Physical Chemistry. | (158) | 3. |
| Mine Engineering<br>Mine Surveying. | (103) | 5. | Mechanical Eng.<br>Mechanism and Design. | (110) | 3. |
| Ceramic Engineering<br>Ceramic Manufacture. | (103) | 5. | Ceramic Engineering<br>Ceramic Manufacture. | (104) | 5. |
| | | | Ceramic Engineering<br>Phys. and Chem. Meas. of Clays. | (108) | 3. |
| | | | Ceramic Engineering<br>Glazes and Colors. | (110) | 2. |

## FOURTH YEAR

| | | | | | |
|---|---|---|---|---|---|
| Ceramic Engineering<br>Drawing. | (113) | 2. | Ceramic Engineering<br>Drawing. | (114) | 3. |
| Ceramic Engineering<br>Laboratory. | (111) | 5. | Ceramic Engineering<br>Laboratory. | (112) | or |
| Mechanical Eng.<br>Lab. and Lecture. | (171) | 4. | Ceramic Engineering<br>Cement Lectures. | (118) | 5. |
| Civil Engineering<br>Trusses. | (123) | 3. | Civil Engineering<br>Cement and Concrete. | (118) | 3. |
| Metallurgy<br>Gen. Metallurgy. | (109) | 4. | Geology<br>General Geology. | (168) | 3. |
| | | | Ceramic Engineering<br>Thesis. | (116) | 4. |

# COURSE IN CHEMICAL ENGINEERING

FOR FIRST YEAR SEE PAGE 18

Summer Session—Students are required to take Shopwork (109) Joinery and Patternmaking, and Shopwork (115) Forging, during the summer session at the close of the first or second year.

## SECOND YEAR

| First Semester | | | Second Semester | | |
|---|---|---|---|---|---|
| Mathematics<br>Calculus. | (141) | 5. | Mathematics<br>Calculus. | (142) | 5. |
| Physics<br>Gen. Physics. | (111) | 3. | Physics<br>Gen. Physics. | (112) | 3. |
| Engineering Drawing<br>Desc. Geom. | (103) | 3. | Engineering Drawing<br>Machine Sketching. | (104) | 3. |
| Chemistry<br>Quantitative Analysis. | (119) | 4. | Chemistry<br>Quantitative Analysis. | (120) | 4. |
| Chemistry<br>Adv. Gen. Chemistry. | (113) | 2. | Chemistry<br>Adv. Gen. Chemistry. | (114) | 2. |
| | | | Chemistry<br>Chemical Problems. | (124) | 1. |
| Military Drill | | 1. | Military Drill | | 1 |

## THIRD YEAR

| REQUIRED | | | REQUIRED | | |
|---|---|---|---|---|---|
| Mechanics<br>Statics and Str. of Mater'ls. | (101) | 5. | Mechanics<br>Strength of Materials, Kinetics and Hydraulics. | (102) | 5. |
| Engineering Drawing<br>Technical Drawing. | (121) | 2. | Engineering Drawing<br>Technical Drawing. | (122) | 2. |
| Metallurgy<br>Gen Metallurgy. | (109) | 4. | Metallurgy<br>Mineralogy and Crystallography. | (104) | 2. |
| Chemistry<br>Organic Chem., lec. | (151) | 2. | Chemistry<br>Organic Chem., lec. | (152) | 2. |
| Chemistry<br>Organic Chem., lab. | (153) | 2. | Electives<br>(See foot note.) | | 6 to 8. |
| Mechanical Eng.<br>Steam Power Plants. | (103) | 3. | | | |

## FOURTH YEAR

| | | | | | |
|---|---|---|---|---|---|
| Mechanical Eng.<br>Machine Design. | (127) | 5. | Mechanical Eng.<br>Machine Design. | (144) | 5. |
| Chemistry<br>Physical Chemistry | (157) | 3. | Chemistry<br>Physical Chemistry. | (158) | 3. |
| Chemistry<br>Industrial Chemistry. | (179) | 4. | Chemistry<br>Industrial Chemistry. | (180) | 4. |
| Electrical Eng.<br>Elementary Elec. Eng. | (101) | 5. | Chemistry<br>Thesis. | (140) | 4. |
| | | | Elective | | 2. |
| Chemistry | (182) | | | | |
| Inspection Trip, or | | | Chemistry | (184) | |

Electives in third year, second semester, must be chosen from the following courses, subject to approval of the departments concerned: Chemistry (136) 2 Chemical Literature, Chemistry (154) 2 or 3 Advanced Organic Chemistry, Chemistry (168) 3 to 5 Advanced Qualitative Analysis, Chemistry (176) 3 Sanitary Analysis, Chemistry (188) 2 or 3 Inorganic Preparations, Metallurgy (110) 4 General Metallurgy, Metallurgy (112) 2 Calorimetry and Mine Gas Analysis.

## COURSE IN CIVIL ENGINEERING

FOR FIRST YEAR SEE PAGE 18

### SECOND YEAR

| FIRST SEMESTER | | | SECOND SEMESTER | | |
|---|---|---|---|---|---|
| Mathematics<br>Calculus. | (141) | 5. | Mathematics<br>Calculus. | (142) | 5. |
| Physics<br>Gen. Physics. | (111) | 3. | Physics<br>Gen. Physics. | (112) | 3. |
| Engineering Drawing<br>Desc. Geom. | (105) | 3. | Engineering Drawing<br>Adv. Desc. Geom. | (106) | 3. |
| Civil Engineering<br>Land Surveying. | (101) | 4. | Civil Engineering<br>R. R. Survey and Field Prac. | (102) | 4. |
| Civil Engineering<br>Field Prac. & Top. Drawing. | (103) | 3. | Geology<br>Gen. Geology. | (168) | 3. |
| Military Drill | | 1. | Military Drill | | 1. |

SUMMER COURSE—Civil Engineering (104), four weeks of six days per week. Field work in Surveying.

### THIRD YEAR

| | | | | | |
|---|---|---|---|---|---|
| Mechanics<br>Statics and Str. of Mater'ls. | (101) | 5. | Mechanics<br>Strength of Materials, Kinetics and Hydraulics. | (102) | 5. |
| Civil Engineering<br>Topog. Surveying. | (115) | 3. | Civil Engineering<br>Timber Construction. | (108) | 3. |
| Civil Engineering<br>Stereotomy. | (107) | 3. | Civil Engineering<br>Roads and Streets. | (106) | 3. |
| Civil Engineering<br>Sanitary Eng. | (109) | 2. | Civil Engineering<br>Stresses in Structures. | (110) | 4. |
| Electrical Eng.<br>Elementary Elect. | (103) | 3. | Astronomy | (104) | 3. |
| Architecture<br>Photography. | (111) | 2. | | | |

SUMMER COURSE—Civil Engineering (111), four weeks of six days per week. Field work in Surveying.

### FOURTH YEAR

| | | | | | |
|---|---|---|---|---|---|
| Civil Engineering<br>**Bridge Design.** | (113) | 4. | Civil Engineering<br>**Adv. Bridges. Or** | (114) | |
| Civil Engineering<br>**Water Supply.** | (117) | 3. | Civil Engineering<br>**Railways.** | (112) | 4. |
| Civil Engineering<br>**Masonry Construction.** | (115) | 3. | Civil Engineering<br>**Masonry Structures.** | (116) | 3. |
| Astronomy | (105) | 3. | Civil Engineering<br>**Cement and Concrete.** | (118) | 3. |
| Mechanical Eng.<br>**Laboratory.** | (173) | 5. | Civil Engineering<br>**Contracts and Speci.** | (120) | 2. |
| Civil Engineering<br>**Thesis.** | (119) | 1. | Mechanical Eng.<br>**Mechanism and Machine Design.** | (140) | 2. |
| | | | Civil Engineering<br>**Thesis.** | (122) | 4. |

## COURSE IN ELECTRICAL ENGINEERING

FOR FIRST YEAR SEE PAGE 18

SUMMER SESSION—Students are required to take Shopwork (109) Joinery and Patternmaking, and Shopwork (115) Forging, during the summer session at the close of the first year.

### SECOND YEAR

| FIRST SEMESTER | | | SECOND SEMESTER | | |
|---|---|---|---|---|---|
| Mathematics<br>**Calculus.** | (141) | 5. | Mathematics<br>**Calculus.** | (142) | 5. |
| Physics<br>**Mechanics and Heat.** | (113) | 5. | Physics<br>**Elec., Light and Sound.** | (114) | 5. |
| Engineering Drawing<br>**Desc. Geometry.** | (103) | 3. | Physics<br>**Laboratory.** | (134) | 5. |
| Engineering Drawing<br>**Machine Sketching.** | (109) | 2. | | | |
| Shopwork<br>**Machine.** | (119) | 3. | Shopwork<br>**Adv. Machine.** | (122) | 3. |
| Military Drill | | 1. | Military Drill | | 1. |

### THIRD YEAR

| | | | | | |
|---|---|---|---|---|---|
| Mechanics<br>**Statics and Str. of Mater'ls.** | (101) | 5. | Mechanics<br>**Strength of Materials, Kinetics and Hydraulics.** | (102) | 5. |
| Physics<br>**Laboratory.** | (135) | 5. | Electrical Eng.<br>**D. C. Machinery.** | (104) | 5. |
| Mechanical Eng.<br>**Steam Power Plants.** | (103) | 3. | Mechanical Eng.<br>**Steam Engines and Boilers.** | (118) | 4. |
| Mechanical Eng.<br>**Mechanism.** | (101) | 3. | Mechanical Eng.<br>**Laboratory.** | (160) | 2. |
| Engineering Drawing<br>**Technical.** | (111) | 2. | Electrical Eng.<br>**Application A. C. Prin.** | (106 & 108) | 3. |

Electrical Engineering (132) Inspection Trip west, at the end of the first semester.

## FOURTH YEAR

| | | | | | |
|---|---|---|---|---|---|
| Mechanical Eng.<br>Laboratory. | (175) | 3. | Electrical Eng.<br>A. C. Laboratory. | (112) | 3. |
| Electrical Eng.<br>A. C. Laboratory. | (111) | 3. | Electrical Eng.<br>Transmission. | (124) | 2. |
| Electrical Eng.<br>A. C. Machinery. | (109) | 3. | Industrial Arts<br>Machine Design. | (112) | 2. |
| Electrical Eng.<br>Elec. Machine Design. | (121) | 3. | Elective | | 3 to 6. |
| Electrical Engineering | (*) | 2. | Electrical Eng.<br>Thesis. | (128) | 5. |
| Electrical Eng.<br>Thesis. | (127) | 1. | | | |
| †Elective | | 2 to 4. | | | |
| ‡Mechanical Eng.<br>Steam Engines and Boilers. | (118) | 3. | | | |

Electrical Engineering (132) Inspection Trip west, at the end of the first semester.

Electives are subject to approval of the head of the department.

## COURSE IN INDUSTRIAL ARTS

FOR FIRST YEAR SEE PAGE 18

SUMMER SESSION—Students are required to take Shopwork (107) Chipping and Filing, and Shopwork (109) Joinery and Patternmaking, during the summer session at the close of the first year.

## SECOND YEAR

| FIRST SEMESTER | | | SECOND SEMESTER | | |
|---|---|---|---|---|---|
| Physics<br>Mechanics and Heat. | (113) | 5. | Physics<br>Elec., Light and Sound. | (114) | 5. |
| Engineering Drawing<br>Desc. Geom. | (103) | 3. | Engineering Drawing<br>Machine Sketching. | (104) | 3. |
| Mathematics<br>Calculus. | (141) | 5. | Shopwork<br>Adv. Pattern Making. | (112) | 2. |
| Shopwork<br>Forging. | (115) | 2. | Shopwork<br>Foundry. | (106) | 2. |
| Economics<br>Principles of Econ. | (135) | 3. | Economics<br>Principles of Econ. | (136) | 3. |
| | | | Economics<br>Ind. History. | (132) | 3. |
| Military Drill | | 1. | Military Drill | | 1. |

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*One of the following: (113) Railways, (115) Telephones, (117) Illumination, (119) Wireless Telegraphy.

† Not required in 1910-1911.

‡ Given only in 1910-1911.

### THIRD YEAR

| | | | | | |
|---|---|---|---|---|---|
| Industrial Arts<br>Machines. | (101) | 3. | Industrial Arts<br>Machines. | (102) | 3. |
| Industrial Arts<br>Designing. | (103) | 2. | Industrial Arts<br>Designing. | (104) | 2. |
| Shopwork<br>Machine Work. | (119) | 3. | Shopwork<br>Adv. Machine Work. | (122) | 3. |
| Mechanical Eng.<br>Power Plants. | (103) | 3. | Mechanical Eng.<br>Steam Engines and Boilers. | (118) | 4. |
| Metallurgy<br>Fuels, Irons and Steels. | (109) | 4. | Mechanical Eng.<br>Laboratory. | (162) | 2. |
| Economics<br>Accts. and Statistics. | (137) | 2. | Economics<br>Accts. and Statistics. | (138) | 2. |
| | | | Economics<br>Cost Accounting. | (172) | 3. |

### FOURTH YEAR

| | | | | | |
|---|---|---|---|---|---|
| Industrial Arts<br>Shop Construction. | (105) | 3. | Industrial Arts<br>Shop Construction. | (106) | 3. |
| Industrial Arts<br>Adv. Designing. | (107) | 3. | Industrial Arts<br>Adv. Designing. | (108) | 3. |
| Shopwork<br>Adv. Machine Work. | (123) | 2. | Civil Engineering<br>Surveying. | (128) | 2. |
| Economics<br>Corporations. Or | (163) | | Economics<br>Ind. Organization. | (164) | or |
| Economics<br>Labor Problems. | (165) | 3. | Economics<br>Labor Problems. | (166) | 3. |
| Electrical Eng.<br>Lect. and Lab. | (101) | 5. | Electives | | 2 or 3. |
| Mechanical Eng.<br>Laboratory. | (177) | 2. | Industrial Arts<br>Thesis. | (130) | 4. |

## COURSE IN MECHANICAL ENGINEERING

FOR FIRST YEAR SEE PAGE 18

SUMMER SESSION—Students are required to take Shopwork (109) Joinery and Patternmaking, and Shopwork (115) Forging, during the summer session at the close of the first year.

### SECOND YEAR

| FIRST SEMESTER | | | SECOND SEMESTER | | |
|---|---|---|---|---|---|
| Mathematics<br>Calculus. | (141) | 5. | Mathematics<br>Calculus. | (142) | 5. |
| Physics<br>Mechanics and Heat. | (113) | 5. | Physics<br>General Physics. | (112) | 3. |
| Engineering Drawing<br>Desc. Geometry. | (103) | 3. | Engineering Drawing<br>Machine Sketching. | (104) | 3. |
| Shopwork<br>Foundry, Chipping, Filing. | (105 and 107) | 3. | Shopwork<br>Machine Work. | (120) | 3. |
| Shopwork<br>Adv. Pattern Making. | (111) | 2. | Physics<br>Laboratory. | (138) | 2. |
| Military Drill | | 1. | Civil Engineering<br>Surveying. | (128) | 2. |
| | | | Military Drill | | 1. |

## THIRD YEAR

| | | | | | |
|---|---|---|---|---|---|
| Mechanics<br>Statics and Str. of Mater'ls. | (101) | 5. | Mechanics<br>Strength of Materials, Kinetics and Hydraulics. | (102) | 5. |
| Engineering Drawing<br>Technical Drawing. | (111) | 2. | Architecture<br>Photography. | (112) | 2. |
| Metallurgy<br>General Metallurgy. | (109) | 4. | Civil Engineering<br>Timber and Masonry. | (126) | 2. |
| Mathematics<br>Diff. Equations. | (151) | 1. | Mechanical Eng.<br>Mechanism. | (114) | 3. |
| Shopwork<br>Adv. Machine Work. | (121) | 3. | Mechanical Eng.<br>Mechanism Drawing. | (116) | 1. |
| Mechanical Eng.<br>Steam Power Plants. | (103) | 3. | Mechanical Eng.<br>Steam Engines and Boilers. | (118) | 4. |
| | | | Mechanical Eng.<br>Laboratory. | (164) | 2. |

Mechanical Engineering (133) Inspection Trip west, at the end of the first semester.

## FOURTH YEAR

| | | | | | |
|---|---|---|---|---|---|
| *Civil Engineering<br>Trusses. | (123) | 3. | Industrial Arts<br>Shop Buildings. | (114) | or |
| Electrical Eng.<br>Elementary Elec. Eng. | (101) | 5. | Mechanical Eng.<br>Steam Turbines. | (146) | 2. |
| Mechanical Eng.<br>Machine Design. | (127) | 5. | Mechanical Eng.<br>Machine Design. | (144) | 5. |
| Mechanical Eng.<br>Gas Engines and Producers. | (125) | 2. | Mechanical Eng.<br>Hydraulic Machinery. | (142) | 2. |
| Mechanical Eng.<br>Thermodynamics. | (129) | 2. | Mechanical Eng.<br>Laboratory. | (190) | 6. |
| Mechanical Eng.<br>Laboratory. | (179) | 2. | Mechanical Eng.<br>Thesis. | (148) | 3. |
| †Mechanical Eng.<br>Steam Engines and Boilers. | (118) | 3. | | | |

Mechanical Engineering (133) Inspection Trip west, at the end of the first semester.

Students who, for financial or other satisfactory reasons, are unable to take Mechanical Engineering (133) may substitute Mechanical Engineering (137) upon receiving permission from the head of the department.

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* Not given in 1910-1911.

† Given only in 1910-1911.

# COURSE IN MINE ENGINEERING

FOR FIRST YEAR SEE PAGE 18

SUMMER SESSION—Students are required to take Shopwork (109) Joinery and Patternmaking, and Shopwork (115) Forging, during the summer session at the close of the first year.

## SECOND YEAR

| First Semester | | | Second Semester | | |
|---|---|---|---|---|---|
| Mathematics<br>**Calculus.** | (141) | 5. | Mathematics<br>**Calculus.** | (142) | 5. |
| Physics<br>**General Physics.** | (111) | 3. | Physics<br>**General Physics.** | (112) | 3. |
| Engineering Drawing<br>**Desc. Geom.** | (103) | 3. | Engineering Drawing<br>**Machine Sketching.** | (104) | 3. |
| Chemistry<br>**Quantitative Analysis.** | (119) | 3. | Chemistry<br>**Chemical Problems.** | (124) | 1. |
| Mine Engineering<br>**Mine Surveying.** | (103) | 5. | Metallurgy<br>**Laboratory.** | (106) | 4. |
| | | | Metallurgy<br>**Mineralogy and Crystallography.** | (104) | 2. |
| Military Drill | | 1. | Military Drill | | 1. |

## THIRD YEAR

| | | | | | |
|---|---|---|---|---|---|
| Mechanics<br>**Statics and Str. of Mater'ls** | (101) | 5. | Mechanics<br>**Strength of Materials, Kinetics and Hydraulics.** | (102) | 5. |
| Metallurgy<br>**Gen. Metallurgy.** | (109) | 4. | Metallurgy<br>**Gen. Metallurgy.** | (110) | 4. |
| Metallurgy<br>**Fire Assaying.** | (105) | 3. | Metallurgy<br>**Calorimetry and Mine Gas Analysis.** | (112) | 2. |
| Metallurgy<br>**Laboratory.** | (107) | 4. | Metallurgy<br>**Determinative Mineralogy.** | (108) | 3. |
| Geology<br>**Gen. Geology.** | (165) | 3. | Geology<br>**Petrography.** | (166) | 2. |
| | | | Civil Engineering<br>**Trusses.** | (124) | 3. |

## FOURTH YEAR

| | | | | | |
|---|---|---|---|---|---|
| Mine Engineering<br>**General Mining.** | (105) | 5. | Mine Engineering<br>**Gen. Mining.** | (106) | 5. |
| Metallurgy<br>**Metallurgical Const.** | (111) | 2. | Mine Engineering<br>**Mine Plans and Speci.** | (104) | 4. |
| Metallurgy<br>**Ore Dressing.** | (113) | 2. | Metallurgy<br>**Metallography, etc.** | (114) | 3. |
| Electrical Eng.<br>**Elementary Elec.** | (103) | 3. | Mechanical Eng.<br>**Laboratory.** | (192) | 3. |
| Geology<br>**Economic Geology.** | (167) | 3. | Thesis | | |
| Architecture<br>**Photography.** | (111) | 2. | | | |

# TWO-YEAR COURSES

## SHORT COURSE IN CLAYWORKING

### FIRST YEAR

| FIRST SEMESTER | | SECOND SEMESTER | |
|---|---|---|---|
| Mathematics (101)<br>Elementary Algebra. | 5. | Mathematics (102)<br>Elementary Algebra. | 5. |
| Mathematics (113)<br>Plane and Solid Geom. | 5. | Mathematics (114)<br>Solid Geom. and Trigo. | 5. |
| Chemistry (101)<br>Elementary Chemistry. | 4. | Chemistry (102)<br>Elementary Chemistry and Qualitative Analysis. | 4. |
| Engineering Drawing (113)<br>Freehand and Lettering. | 4. | Engineering Drawing (114)<br>Mechanical Drawing. | 3. |
| Military Drill | 1. | Military Drill | 1. |
| Gymnasium | 1. | Gymnasium | 1. |

SUMMER SESSION—Students are required to take *Shopwork (109) Joinery and Patternmaking, and Shopwork (115) Forging, during the summer session at the close of the first year.

### SECOND YEAR

| | | | |
|---|---|---|---|
| Ceramic Engineering (101)<br>Ceramic Chemistry. | 5. | Ceramic Engineering (104)<br>Clay Manufacture. | 5. |
| Ceramic Engineering (103)<br>Clay Manufacture. | 5. | Ceramic Engineering (110)<br>Glazes and Colors. | 2. |
| Ceramic Engineering (115)<br>Laboratory. | 2. | Ceramic Engineering (112)<br>Laboratory. | 5. |
| Physics (101)<br>Elementary Physics. | 6. | Ceramic Engineering (106)<br>Ceramic Calculations. | 2. |
| | | Ceramic Engineering (120)<br>Lab. in Calculations. | 1. |
| Military Drill | 1. | Ceramic Engineering (122)<br>Dryer and Kiln Design. | 2. |
| | | Military Drill | 1. |

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* Upon presentation of reasons satisfactory to the head of the department, students may substitute work in a ceramic factory for the above shopwork courses.

## SHORT COURSE IN INDUSTRIAL ARTS

### FIRST YEAR

| First Semester | | | Second Semester | | |
|---|---|---|---|---|---|
| Mathematics<br>Elementary Algebra. | (101) | 5. | Mathematics<br>Elementary Algebra. | (102) | 5. |
| Mathematics<br>Plane and Solid Geom. | (113) | 5. | Mathematics<br>Solid Geom. and Trigo. | (114) | 5. |
| Engineering Drawing<br>Freehand and Lettering. | (113) | 4. | Engineering Drawing<br>Mechanical Drawing. | (114) | 3. |
| Shopwork<br>Pattern Making. | (109) | 2. | Shopwork<br>Adv. Pattern Making. | (112) | 2. |
| Shopwork<br>Forging. | (115) | 2. | Shopwork<br>Foundry, Chipping, Filing. | (106 and 108) | 3. |
| Military Drill | | 1. | Military Drill | | 1. |
| Gymnasium | | 1. | Gymnasium | | 1. |

### SECOND YEAR

| | | | | | |
|---|---|---|---|---|---|
| Engineering Drawing<br>Desc. Geometry. | (103) | 3. | Engineering Drawing<br>Machine Sketching. | (104) | 3. |
| Industrial Arts<br>Machines. | (101) | 3. | Industrial Arts<br>Machines. | (102) | 3. |
| Industrial Arts<br>Designing. | (103) | 2. | Industrial Arts<br>Designing. | (104) | 2. |
| Physics<br>Elementary Physics. | (101) | 6. | Industrial Arts<br>Strength of Materials. | (110) | 6. |
| Shopwork<br>Machine Work. | (119) | 3. | Shopwork<br>Adv. Machine Work. | (122) | 3. |
| Military Drill | | 1. | Military Drill | | 1. |

# SHORT COURSE IN MINING

## FIRST YEAR

| FIRST SEMESTER | | | SECOND SEMESTER | | |
|---|---|---|---|---|---|
| Mathematics<br>Elementary Algebra. | (101) | 5. | Mathematics<br>Elementary Algebra. | (102) | 5. |
| Mathematics<br>Plane and Solid Geom. | (113) | 5. | Mathematics<br>Solid Geom. and Trigo. | (114) | 5. |
| Physics<br>Elementary Physics. | (101) | 6. | Shopwork<br>Forging. | (116) | 2. |
| | | | Geology<br>Elementary Physiography. | (162) | 4. |
| Military Drill | | 1. | Military Drill | | 1. |
| Gymnasium | | 1. | Gymnasium | | 1. |

## SECOND YEAR

| | | | | | |
|---|---|---|---|---|---|
| Engineering Drawing<br>Freehand and Lettering. | (113) | 4. | Engineering Drawing<br>Mechanical Drawing. | (114) | 3. |
| Chemistry<br>Elementary Chemistry. | (101) | 4. | Geology<br>Elementary Geology. | (164) | 3. |
| Mine Engineering<br>Mine Plans. | (107) | 2. | Metallurgy<br>Water Supply and Mine Gases. | (102) | 4. |
| Mine Engineering<br>Mine Surveying. | (101) | 5. | Mine Engineering<br>General Mining. | (102) | 5. |
| Military Drill | | 1. | Military Drill | | 1. |

# DEPARTMENTS OF INSTRUCTION

## ARCHITECTURE

(Office, Room 22, Brown Hall)

PROFESSOR BRADFORD, ASSOCIATE PROFESSOR CHUBB, MR. HASKETT

**Equivalent term courses: 101-102=9, 10, 11; 103-104=12, 13, 14; 105=26; 106=27; 107-108=15, 17, 23; 109=5; 110=24; 111 or 112=33; 113=22; 114-115=18, 21, 30; 116=4, 28, 29; 117=25; 118=20; 119=34; 120=31.**

101. History of Architecture. Three credit hours. Architecture second year, first semester. Professor Bradford.

Lectures, illustrated by lantern slides.

102. Continuation of 101. Architecture, second year, second semester. Professor Bradford.

103. Order Problems. Two credit hours. Architecture, second year, first semester. Prerequisite, Engineering Drawing (107). Assistant Professor Chubb.

Drawing details of the Orders.

104. Order Problems. Five credit hours. Architecture, second year, second semester. Prerequisite, Architecture 103. Associate Professor Chubb.

105. Shades, Shadows, and Perspective. Three credit hours. Architecture, second year, first semester. Prerequisite, Engineering Drawing (107). Associate Professor Chubb.

106. Architectural Stereotomy. Three credit hours. Architecture, second year, second semester. Prerequisite, Architecture 105. Professor Bradford.

Lectures and practice. Arches, vaults, domes, wing walls, stair ramps, etc.

107. Design. Five credit hours. Lectures and practice. Architecture, third year, first semester. Prerequisite, Architecture 104. Professor Bradford.

108. Design. Four credit hours. Architecture, third year, second semester. Prerequisite, Architecture 107. Associate Professor Chubb.

109. Decoration and Ornament. Three credit hours. Archi-

tecture, third year, first semester. Prerequisite, Architecture 104. Associate Professor CHUBB.

110. WORKING DRAWINGS. Four credit hours. Architecture, third year, second semester. Prerequisite, Architecture 107. Professor BRADFORD.

111. PHOTOGRAPHY. Two credit hours. Civil Engineering, third year, first semester; Mine Engineering, fourth year, first semester. Prerequisite, Chemistry 105, 106, or 109, 110. Mr. HASKETT.

112. PHOTOGRAPHY. Two credit hours. Mechanical Engineering and Architecture, third year, second semester. Prerequisite, Chemistry, 105, 106, or 109, 110. Mr. HASKETT.

113. PRINCIPLES OF ARCHITECTURAL COMPOSITION. Two credit hours. Architecture, third year, first semester. Concurrent, Architecture 109. Associate Professor CHUBB.

114. DESIGNING. Three credit hours. Architecture, fourth year, second semester. Prerequisite 108. Professor BRADFORD, Associate Professor CHUBB.

115. DESIGNING. Six credit hours. Architecture, fourth year, first semester. Prerequisite, Architecture 103. Professor BRADFORD.

116. PROFESSIONAL PRACTICE. Four credit hours. Architecture, fourth year, second semester. Prerequisite, 114. Professor BRADFORD.

Lectures on relations of architect and owner, architect and contractor, duties of supervisor of erection, contracts, specifications, estimates, and office practice.

117. SANITARY PLUMBING. One credit hour. Architecture, fourth year. first semester. Professor BRADFORD.

118. THESIS. Five credit hours. Architecture, fourth year, second semester.

Original design to be accompanied with written description, specifications and estimate.

119. MASONRY. Two credit hours. Architecture, fourth year, first semester. Prerequisite, 110.

120. SUMMER WORK. The equivalent of four weeks of work in an architect's office, or working up a problem in design assigned by the department.

Summer vacation at end of Sophomore or Junior year.

## ASTRONOMY

(Office, Emerson McMillen Observatory)

PROFESSOR H. C. LORD, ASSOCIATE PROFESSOR MANSON

**Equivalent term course: 104-105=4, 5, 6.**

104. ASTRONOMY, GEODESY, AND LEAST SQUARES. Three credit hours. Civil Engineering, third year, second semester. Prerequisite, Mathematics 142. Professor LORD, Associate Professor MANSON.

105. Continuation of 104. Three credit hours. Civil Engineering, fourth year, first semester. Professor LORD, Associate Professor MANSON.

## CERAMIC ENGINEERING

(Office, Room 131, Mines Building)

PROFESSOR ORTON, ASSOCIATE PROFESSOR PURDY, ASSISTANT PROFESSOR STALEY, MR. WORCESTER

**Equivalent term courses: 101-102=1, 2, 3; 103-104=4, 5, 6; 106 =24; 108=26; 110=27; 111-112=9, 10, 11; 115=20; 118=12.**

101. CERAMIC CHEMISTRY. Five credit hours. Ceramic Engineering and Short Clay-working, second year, first semester. Prerequisite, Chemistry 106 or 110. Assistant Professor STALEY.

Quantitative analysis of limestone and simple minerals.

102. CERAMIC CHEMISTRY. Three credit hours. Ceramic Engineering, second year, second semester. Prerequisite, Ceramic Engineering 101. Assistant Professor STALEY.

Quantitative analysis of clays, fire gases, etc.

103. CERAMIC MANUFACTURE. Five credit hours. Ceramic Engineering, third year, first semester; Short Clay-working, second year, first semester. Professor ORTON.

Origin, occurrence, constitution, properties and methods of winning ceramic material.

104. Continuation of 103. Five credit hours. Ceramic Engineering, third year; Short Clay-working, second year, second semester. Professor ORTON.

General principles of manufacture of clay wares; theory and practice of drying and burning.

106. CERAMIC CALCULATIONS. Two credit hours. Ceramic Engineering and Short Clay-working, second year, second semester. Prerequisite, Ceramics 101. Associate Professor PURDY.

Calculations involved in blending of ingredients used in ceramic mixtures; determinations of limits of variation in given series; limits of errors; volume calculations; problems in heat.

108. PHYSICAL AND CHEMICAL MEASUREMENTS OF CLAYS. Three credit hours. Ceramic Engineering, third year, second semester. Assistant Professor STALEY.

Application of physical chemical laws to fusions of mineral mixtures; determination of melting points; deformation periods; relative viscosity of fused magmas; study of influence of salts on viscosity of slips.

110. COLORS AND GLAZES. Two credit hours. Ceramic Engineering, third year, second semester; Short Clay-working, second year, second semester. Prerequisite, Ceramics 101 and 103. Professor ORTON.

The decoration of clay wares by glazing and coloring. This course deals with decoration from the technological side only, not touching upon the artistic.

111. LABORATORY WORK IN CERAMICS. Five credit hours. Ceramic Engineering, fourth year, first semester. Associate Professor PURDY, Mr. WORCESTER.

Practice in clay testing and measurement of physical properties of clays; the production of bodies made from single clays and of clays with minerals. In each case the bodies are burned and tested.

112. Continuation of 111. Five credit hours. Ceramic Engineering, fourth year, second semester; Short Clay-working, second year, second semester. Associate Professor PURDY, Mr. WORCESTER.

The production of slips. engobes, and glazes, and the study of the methods of coloring.

113. CERAMIC DESIGNING. Two credit hours. Ceramic Engineering, fourth year, first semester. Prerequisite, Ceramics 141. Mr. WORCESTER.

Designing, estimating cost of and writing specifications for kilns and dryers.

114. Continuation of 113. Three credit hours. Ceramic Engineering, fourth year, second semester. Mr. WORCESTER.

The work started in Ceramics 113 will be extended to the design and equipment of clay-working plants.

115. LABORATORY WORK IN CERAMICS. Two credit hours. Short Clay-working, second year, first semester. Concurrent, Ceramics 103. Associate Professor PURDY.

Testing of clays and minerals employed in clay manufacture and in blending of same for ceramic purposes.

116. THESIS. Four credit hours. Ceramic Engineering, fourth year, second semester.

118. CEMENT MANUFACTURE. Five credit hours. Alternative with Ceramics 112. Ceramic Engineering, fourth year, second semester. Prerequisite, Ceramics 102 and 141. Associate Professor PURDY.

The theory of hydraulicity, the compounding, manufacture, and testing of natural and Portland cements and other hydraulics.

120. LABORATORY DRILL IN CERAMIC CALCULATIONS. One credit hour. Short Clay-working, second year, second semester. Associate Professor PURDY.

122. DRYER AND KILN DESIGN. Two credit hours. Short Clay-working, second year, second semester. Concurrent with Ceramics 106. Mr. WORCESTER.

A graphic study of dryer and kiln design.

124. CERAMIC SPECIAL. Three to five credit hours. Time to be arranged.

This course is given to furnish opportunity for studies along special lines or investigations in some particular field of ceramics. Students in Ceramic Engineering, who have completed their third year work, and students who have completed their second year Short Clay-working, often desire to make special investigations under the direction of the instructional force. Opportunity for such work is given in this course.

## CHEMISTRY

(Office, Chemistry Hall)

PROFESSOR MCPHERSON, EMERITUS PROFESSOR NORTON, PROFESSORS HENDERSON, FOULK, ASSOCIATE PROFESSORS EVANS AND WITHROW, DR. WILKINSON, MR. KELLOGG, AND DEPARTMENT ASSISTANTS

Equivalent term courses: 101-102=3, 45; 105-106=7, 12; 109-110=44, 12; 113-114=21; 119-120=20; 124=40; 136=77; 151-152=46; 153-154=47; 157-158=30; 161-162=50; 176=15; 179-180=32; 182=78; 184=79; 187-188=17; 191=35; 194=72.

101. ELEMENTARY CHEMISTRY. Four credit hours. First semester. One lecture, one quiz, six hours laboratory weekly. Short Mining, second year; Short Clay-working, first year, first semester. Associate Professor EVANS, Mr. STRATTON.

A general introductory course on the chemistry of the non-metals. It is distinctly elementary in character, and is arranged for students in short courses only. No credit is allowed for it in the regular four year courses. Students taking this course should follow with course 102, second semester.

102. ELEMENTARY CHEMISTRY AND QUALITATIVE ANALYSIS. Continuation of Chemistry 101. Short courses. Second semester. Associate Professor EVANS, Mr. WITZEMANN.

A general introductory course on the chemistry of the metals. The laboratory work deals with the elementary principles of qualitative analysis. The course is arranged for students in short courses only. No credit is allowed for it in the regular four year courses.

105. ELEMENTARY CHEMISTRY. Four credit hours. One lecture, one quiz, and six hours laboratory weekly. Taken by first year students in all four year courses who have not presented Chemistry for entrance requirement, first semester. Associate Professor EVANS, Miss MORGAN, Mr. HALL, Mr. STRATTON.

A general course in the Chemistry of non-metals.

106. ELEMENTARY CHEMISTRY AND QUALITATIVE ANALYSIS. A continuation of Chemistry 105. Four credit hours. Second semester. Associate Professor EVANS, Miss MORGAN, Mr. STRATTON, and Mr. KELLOGG.

A general course in the Chemistry of the metals. The laboratory work accompanying is a general introductory course in qualitative analysis.

109. GENERAL CHEMISTRY. Four credit hours. One lecture, one quiz, and six hours laboratory weekly. Taken by first year students in all four year courses who have presented Chemistry as an entrance requirement, first semester. Associate Professors EVANS and WITHROW. Mr. KELLOGG, and Mr. WITZEMANN.

A general course on the chemistry of non-metals.

110. GENERAL CHEMISTRY AND QUALITATIVE ANALYSIS. A continuation of Chemistry 109. Four credit hours. Second semester. Associate Professor EVANS, Mr. KELLOGG, Miss MORGAN, and Mr. STRATTON.

A general course in the chemistry of the metals. It is more advanced than Chemistry 106. The laboratory work is a general course in qualitative analysis.

113. ADVANCED GENERAL CHEMISTRY. Two credit hours. Two lectures weekly. Chemical Engineering, second year, first semester. Prerequisite, Chemistry 106 or 110. Professor HENDERSON.

A course on the fundamental topics of Advanced General Chemistry.

114. ADVANCED GENERAL CHEMISTRY. A continuation of Chemistry 113. Two credit hours. Chemical Engineering, second year, second semester. Professor HENDERSON.

119. QUANTITATIVE ANALYSIS. Three credit hours. One lecture and six hours laboratory weekly. Mine Engineering, second year, first semester. Four credit hours. One lecture and nine hours laboratory weekly. Chemical Engineering, second year, first semester. Prerequisite, Chemistry 106 or 110. Professor FOULK, Mr. SWEENEY.

The elementary principles of gravimetric and volumetric analysis.

120. QUANTITATIVE ANALYSIS. Four credit hours. One lecture and nine hours laboratory weekly. Chemical Engineering, second year, second semester. Prerequisite, Chemistry 119. A continuation of Chemistry 119 with typical analytical methods in gravimetric and volumetric analysis. This course must be accompanied by Chemistry 124. It is desirable that it be accompanied by Chemistry 114.

124. CHEMICAL PROBLEMS. One credit hour. Chemical Engineering, second year, second semester. Professor FOULK.

Extended practice in the solution of problems pertaining to gravimetric and volumetric analysis. This course is arranged to accompany Chemistry 120.

136. THE READING OF CHEMICAL LITERATURE. Two credit hours. Chemical Engineering, elective, third year, second semester. Prerequisite, first year of German. Professor FOULK.

The object of this course is to afford practice in the rapid reading of German chemical literature, the selections being made with special reference to the technical terms of the science.

140. THESIS. Four credit hours. Chemical Engineering, fourth year, second semester.

151. ORGANIC CHEMISTRY. Two credit hours. Two lectures weekly. Chemical Engineering, third year, first semester. Prerequisite, Chemistry 114 and 120. Professor MCPHERSON.

General course in Organic Chemistry.

152. ORGANIC CHEMISTRY Continued. Two credit hours. Two lectures weekly. Chemical Engineering, third year, second semester. Prerequisite, Chemistry 151. Professor MCPHERSON.

153. ORGANIC CHEMISTRY. Two or three credit hours. Six or nine hours laboratory weekly. Chemical Engineering, third year, first semester. Must be accompanied or preceded by Chemistry 151. Professor MCPHERSON, Mr. BOORD.

A general course in the preparation of typical organic compounds.

154. ORGANIC CHEMISTRY Continued. Two or three credit hours. Six or nine hours laboratory weekly. Chemical Engineering, elective third year, second semester. Must be preceded or accompanied by Chemistry 152. Professor MCPHERSON, Mr. BOORD.

157. PHYSICAL CHEMISTRY. Three credit hours. Three lectures weekly. Chemical Engineering, fourth year, first semester, and Ceramic Engineering, third year, first semester. Prerequisite, Chemistry 114, 120, and 152. Professor HENDERSON.

This is a general course in Physical Chemistry.

158. PHYSICAL CHEMISTRY. Three credit hours. Three lectures weekly. Chemical Engineering, fourth year, second semester. Ceramic Engineering, third year, second semester. Prerequisite, Chemistry 157. Professor HENDERSON.

162. Physical Chemistry. Two or three credit hours. Six or nine hours laboratory weekly. Second semester. Professor HENDERSON.

168. QUALITATIVE ANALYSIS. Advanced course. Three to five credit hours. One lecture six to twelve hours laboratory weekly. Chemical Engineering, elective third year, second semester. Prerequisite, Chemistry 120, or equivalent. Professor FOULK.

Extended work in general qualitative analysis including the more important of the rare elements.

176. SANITARY ANALYSIS. Three credit hours. Two lectures and three hours laboratory weekly. Chemical Engineering, elective third year, second semester. Prerequisite, Chemistry 120, or equivalent. Professor FOULK.

A study of the methods of sanitary water analysis and interpretation of results.

179. INDUSTRIAL CHEMISTRY. Four credit hours. Two lectures, one conference, five hours laboratory weekly. Chemical Engineering, fourth year, first semester. Prerequisite, Chemistry 120 and 153. Associate Professor WITHROW.

The lectures take up industrial operations underlying the chemical industries followed by a study of the inorganic chemical industries. The laboratory work includes industrial research problems involving an idea of cost and the fundamental industrial operations such as crystallization, lixiviation, distillation, etc.

180. INDUSTRIAL CHEMISTRY. Four credit hours. One lecture, one conference, eight hours laboratory weekly. Chemical Engineering, fourth year, second semester. Prerequisite, Chemistry 179. Associate Professor WITHROW.

The lectures take up the study of organic chemical industries followed by discussions of the methods of factory control in the chemical industries and the chemical examination of raw material and various commercial products. The laboratory work consists of a series of industrial problems in the utilization of waste and by-products followed by chemical examinations of a variety of types of commercial products.

182. INDUSTRIAL INSPECTION TRIP. A four to six days excursion at a suitable time in connection with 179-180 for the inspection of industrial chemical processes in actual operation. The entire expense varies from $15 to $30. A satisfactory report on the work inspected is required. The trips are under the immediate charge of Associate Professor WITHROW.

184. WRITTEN REPORTS. A course of assigned reading upon some industrial chemical process and a written report on same. This course is a substitute for course 182, but the substitution is only allowed upon presentation of reasons satisfactory to the instructor in charge. Associate Professor WITHROW.

188. INORGANIC PREPARATION. Two or three credit hours. Six or nine hours laboratory weekly. Chemical Engineering elective, third year, second semester. Prerequisite, Chemistry 114. Professor HENDERSON.

A course in the preparation of a limited number of compounds chosen so as to give practice in the different kinds of manipulation involved in the preparation of inorganic compounds.

191. RARE ELEMENTS. Two credit hours. Two lectures weekly. Elective. Prerequisite, Chemistry 114 and 120. Professor HENDERSON.

A general course on the chemistry of the rare elements, including a discussion of their increasing economic importance.

194. APPLIED ELECTRO-CHEMISTRY. Two credit hours. Two lectures weekly. Elective, second semester. Prerequisite, Chemistry 158, except by the special permission of the instructor. Associate Professor WITHROW.

A descriptive course covering the application of the Electric Current in Chemical industries.

## CIVIL ENGINEERING

(Office Room 33 ,Brown Hall)

PROFESSOR SHERMAN, PROFESSOR ENO, PROFESSOR MORRIS, ASSISTANT PROFESSOR SCHLAFLY, ASSISTANT PROFESSOR CHAMBERLIN, MR. WARD, MR. HINKLE

Equivalent term courses: 101=30; 102=32, 33; 103=31, 4; 104=22; 105=3; 106=16; 107=6; 108=24; 109=10; 110=7; 111=23; 112=17; 113=8; 114=25; 115=34; 116=35; 117=18; 118=36, 14; 120=37; 123-124=19; 125=28; 126=27; 128=21.

101. LAND SURVEYING. Four credit hours. Four recitations weekly. Civil Engineering, second year, first semester. Prerequisite, Mathematics 132, Engineering Drawing 102.

Care and Use of Instruments. Farm, City, and Hydrographic Surveying.

102. RAILROAD SURVEYING. Four credit hours. Three recitations and three hours field work per week, second year, second semester. Prerequisite, Civil Engineering 101.

Simple, compound, and transition curves, frogs, switches, and earthwork.

103. FIELD PRACTICE AND TOPOGRAPHIC DRAWING. Three credit hours. Nine hours per week in field and office. Civil Engineering, second year, first semester. Prerequisite, Engineering Drawing 102, and concurrent Civil Engineering 101.

Exercises in land surveying in field and in ink and color topography in drawing room.

104. SUMMER SURVEYING CAMP. Civil Engineering at close of second year. Prerequisite, Civil Engineering 101 and 102.

Four weeks of six days per week of ten hours per day, from the middle of June to the middle of July.

105. TOPOGRAPHIC SURVEYING. Three credit hours. Nine hours per week in field or drawing room. Civil Engineering, third year, first semester. Prerequisite, Civil Engineering 101, 102, and 104.

Field and office work in four or five kinds of topographic surveying.

106. ROADS AND STREETS. Three credit hours. Three recitations weekly. Civil Engineering, third year, second semester. Prerequisite, Civil Engineering 102, and 104.

107. STEREOTOMY. Three credit hours. Recitations, lectures, and drawing. Civil Engineering, third year, first semester. Prerequisite, Engineering Drawing 106.

108. TIMBER CONSTRUCTION. Three credit hours. Lectures and laboratory. Civil Engineering, third year, second semester. Prerequisite, Engineering Drawing 105, Concurrent Mechanics 102.

109. SANITARY ENGINEERING. Two credit hours. Two recitations per week. Civil Engineering, third year, first semester. Prerequisite, Civil Engineering 102, and 104.

110. STRESSES IN STRUCTURES. Four credit hours. Four hours recitations weekly. Civil Engineering, third year, second semester. Concurrent Mechanics 102.

111. SUMMER SURVEYING CAMP. Civil Engineering at close of third year. Prerequisite, Civil Engineering 104, and 105.

Four weeks of six days per week of ten hours per day, from the middle of June to the middle of July.

112. RAILWAY LOCATION. Four credit hours. Four recitations per week. Optional with C. E. 114. Civil Engineering, fourth year, second semester. Prerequisite, Civil Engineering 102 and 111, and Mechanics 102.

113. BRIDGE DESIGNING. Four credit hours. Four recitations per week. Civil Engineering, fourth year, first semester. Prerequisite, Civil Engineering 110.

114. ADVANCED BRIDGES. Four credit hours. Four recitations per week. Optional with C. E. 112. Civil Engineering, fourth year, second semester. Prerequisite, Civil Engineering 113.

115. MASONRY CONSTRUCTION. Three credit hours. Three recitations weekly. Civil Engineering, fourth year, first semester. Prerequisite, Civil Engineering 111, Mechanics 102.

116. MASONRY STRUCTURES. Three credit hours. Three recitations, lectures, and drawing per week. Civil Engineering, fourth year, second semester. Prerequisite, Civil Engineering 115.

117. WATER SUPPLY. Three credit hours. Three recitations per week. Civil Engineering, fourth year, first semester. Prerequisite, Civil Engineering 111, Mechanics 102.

118. CEMENT AND CONCRETE. Three credit hours. Architecture, Ceramic, and Civil Engineering, fourth year, second semester. Prerequisite, Mechanics 102, or 104.

119. THESIS. One credit hour. Civil Engineering, fourth year, first semester. Prerequisite, Civil Engineering 110, and 111.

120. CONTRACTS AND SPECIFICATIONS. Two credit hours. Two

recitations weekly. Civil Engineering, fourth year, second semester. Prerequisite, Civil Engineering 106, 109, and 115.

122. THESIS. Four credit hours. Civil Engineering, fourth year, second semester. Prerequisite, Civil Engineering 119.

123. TRUSSES. Lectures, recitations, and drawing. Three credit hours. Ceramic, and Mechanical Engineering, fourth year, first semester. Drawing last three or four weeks. Prerequisite, Mechanics 102, or 104.

124. Repetition of 123. Architecture and Mine Engineering, third year, second semester. Concurrent, Mechanics 102, or 104.

125. TALL BUILDINGS. Three credit hours. Three lectures weekly. Architecture, fourth year, first semester. Prerequisite, Civil Engineering 124.

126. TIMBER AND MASONRY. Two credit hours. Two lectures and recitations weekly. Mechanical Engineering, third year, second semester. Concurrent Mechanics 102.

128. PLANE SURVEYING. Two credit hours. Two lectures and one field exercise of three hours per week. Architecture and Industrial Arts, fourth year, second semester, and Mechanical Engineering, second year, second semester. Prerequisite, Engineering Drawing 102, Mathematics 132.

## DRAWING

(See Engineering Drawing)

## ECONOMICS AND SOCIOLOGY

(Office, Room 211, University Hall)

PROFESSOR HAGERTY, PROFESSOR HAMMOND, ASSISTANT PROFESSORS LOCKHART AND HUNTINGTON

### ECONOMICS

Equivalent term courses: 135-136=33; 139-140=48.

132. ECONOMIC AND SOCIAL HISTORY OF ENGLAND AND THE UNITED STATES. Three credit hours. Second semester. Open only to first and second year students. Associate Professor MCKENZIE.

133. ECONOMIC GEOGRAPHY. Three credit hours. First semester. Open only to first and second year students. Assistant Professor GEPHART.

135-136. PRINCIPLES OF ECONOMICS. Three credit hours. The year. Not open to first year students. Industrial Arts, second year.

Professor HAMMOND, Assistant Professors LOCKHART, GEPHART, and HUNTINGTON.

A careful study of the laws of production, exchange, distribution, and consumption of wealth; combined with an analysis of the industrial actions of men as regards land, labor, capital, money, credit, rent, interest, wages, etc. Text-books, lectures, and individual investigations.

139-140. ACCOUNTING. Two credit hours. Industrial Arts, third year, the year. Prerequisite, registration in course 135-136. Assistant Professor HUNTINGTON.

An introduction to practical accounting, including an analysis and interpretation of business statements.

143. BUSINESS LAW. Three credit hours. First semester. Must be preceded or accompanied by course 135-136. Assistant Professor HUNTINGTON.

A study of the leading legal principles of interest to the business man to be found in the law of contracts, agency, partnership, corporations, personal and real property, suretyship and guaranty, insurance, the estates of decedents, etc.

*163. CORPORATION ECONOMICS. Three credit hours. First semester. Prerequisite, course 135-136. Professor HAMMOND.

The development of corporations. Corporate organization, management, and finance. Forms and methods of industrial consolidations. Monopolistic tendencies in industry. Public regulation of industrial monopolies.

164. INDUSTRIAL ORGANIZATION. Three credit hours. Second semester. Prerequisite, course 135-136. Professor HAMMOND.

The development and internal organization of modern manufacturing enterprises. The forces determining their location. Factory administration. Welfare work. Lectures, reports, and visits of inspection to local plants.

165. LABOR LEGISLATION. Three credit hours. First semester. Prerequisite, course 135-136. Professor HAMMOND.

A study of the labor laws of the United States and the principal foreign countries with reference to their social and economic causes and effects.

166. ORGANIZATION AND REMUNERATION OF LABOR. Three credit

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* Not given in 1910-1911.

hours. Second semester. Prerequisite, course 135-136. Professor HAMMOND.

History of the labor movement. Trade union policies and methods. Employers' organizations. Collective bargaining. Industrial arbitration. Attempts to modify the wage system. Time, piece, and progressive wages. Profit-sharing, labor co-partnership, and cooperation.

172. COST ACCOUNTING. Three credit hours. Second semester. Prerequisite, course 137-138. Assistant Professor HUNTINGTON.

The purpose of cost accounting, the relation of the various elements of cost, and the methods of recording them in various types of industries.

## ELECTRICAL ENGINEERING

(Office, Room 171, Engineering Laboratory)

PROFESSOR CALDWELL, ASSOCIATE PROFESSOR HUNT, ASSISTANT PROFESSOR UPSON, MR. SHEPARDSON

Equivalent term courses: 101=5; 103=31; 104=30; 106=24; 108=15; 109=16, 17; 111-112=11; 113=26; 115=27; 117=28; 119=29; 121=18; 122=19; 124=25; 125-126=32; 130=20; 132=21; 134=22; 136=23.

101. ELECTRICAL ENGINEERING. Five credit hours. Three lectures and one four-hour laboratory period weekly. Chemical Engineering, Industrial Arts, and Mechanical Engineering, fourth year, first semester. Prerequisite, Physics 112, or Physics 114. Associate Professor HUNT, Assistant Professor UPSON.

Lectures and laboratory work on direct and alternating current circuits, dynamo machinery, transformers, accumulators, and their applications.

103. ELECTRICAL ENGINEERING. Three credit hours. Two lectures and one three-hour laboratory period weekly. Civil Engineering, third year, Mine Engineering, fourth year, first semester. Prerequisite, Physics 112, or 114. Associate Professor HUNT, Assistant Professor UPSON.

Lectures and laboratory work on direct current machinery, circuits, and transmission.

104. DIRECT CURRENT MACHINERY. Five credit hours. Three lectures and one four-hour laboratory period weekly. Electrical Engineering, third year, second semester. Prerequisites, Physics 135, and Mathematics 142. Associate Professor HUNT.

Generators and motors, their theory, construction, and operation. Lectures, recitations, problems, and laboratory.

106. APPLICATIONS OF ELECTRICITY. Three hours for one-half semester. Three lectures per week. Electrical Engineering, third year, second semester. Prerequisites, Physics 135, and Mathematics 142. Professor CALDWELL, Assistant Professor UPSON.

A brief treatment of the uses of electricity, illumination, railways, mining, etc.

108. ALTERNATING CURRENT CIRCUITS AND MACHINERY. Three hours for one-half semester. Electrical Engineering, third year, second half of second semester. Prerequisites, Mathematics 142, Physics 135, and Electrical Engineering 106. Professor CALDWELL.

General principles, circuits, generators, and transformers.

109. ALTERNATING CURRENT MACHINERY. A continuation of Electrical Engineering 108. Three credit hours. Three lectures weekly. Electrical Engineering, fourth year, first semester. Prerequisite, Electrical Engineering 108, and concurrent, Electrical Engineering 111. Professor CALDWELL.

Transformers, synchronous motors, induction motors, etc.

111. ALTERNATING CURRENT LABORATORY. Three credit hours. Electrical Engineering, fourth year, first semester. Prerequisite, Electrical Engineering 108, Concurrent Electrical Engineering 109 Professor CALDWELL, Assistant Professor UPSON.

Alternating current, railway and telephone apparatus, accumulators.

112. ADVANCED A. C. LABORATORY. Three credit hours. Electrical Engineering, fourth year, second semester. Prerequisite, Electrical Engineering 109 and 111. Professor CALDWELL, Assistant Professor UPSON.

113. ELECTRICAL RAILWAYS. Two credit hours. Electrical Engineering, fourth year, first semester. Alternative with Electrical Engineering 115, 117, and 119. Prerequisite, Electrical Engineering 104, Concurrent Electrical Engineering 109. Professor CALDWELL.

Systems, apparatus, and operation.

115. TELEPHONY. Two credit hours. Electrical Engineering, fourth year, first semester. Alternative with Electrical Engineering 113, 117, and 119. Prerequisites, Electrical Engineering 104 and 108. Assistant Professor UPSON.

Methods of operation, simple circuits and apparatus, elements of transmission theory.

117. ELECTRIC ILLUMINATION. Two credit hours. Electrical Engineering, fourth year, first semester. Alternative with Electrical

Engineering 113, 115, and 119. Prerequisites, Electrical Engineering 104 and 108. Professor CALDWELL.

Principles of illumination, electric lamps, wiring plans, etc.

119. WIRELESS TELEGRAPHY. Two credit hours. Electrical Engineering, fourth year, first semester. Alternative with Electrical Engineering 113, 115, and 117. Prerequisites, Electrical Engineering 104 and 108. Assistant Professor UPSON.

Elementary theory, production, transmission, and detection of damped and undamped oscillations.

121. ELECTRICAL DESIGN. Three credit hours. Two lectures and one four-hour drawing period weekly. Electrical Engineering, fourth year, first semester. Prerequisite, Electrical Engineering 104. Associate Professor HUNT.

Direct current dynamos, transformers, etc.

122. ELECTRICAL DESIGN. Two credit hours. A continuation of Electrical Engineering 121. One lecture and one three-hour drawing period weekly. Electrical Engineering, fourth year, second semester. Elective. Associate Professor HUNT.

Alternating current apparatus.

124. ELECTRICAL TRANSMISSION AND DISTRIBUTION. Two credit hours. Two lectures weekly. Electrical Engineering, fourth year, second semester. Prerequisite, Electrical Engineering 109. Professor CALDWELL.

Systems, apparatus, and operation.

125. SPECIAL READING AND LABORATORY. Credit hours to be arranged. Elective for fourth year Electrical Engineering and graduate students with consent of the instructor in charge. First semester. Prerequisites, Electrical Engineering 104 and 108.

126. SPECIAL READING AND LABORATORY. A continuation of Electrical Engineering 125. Second semester.

127. THESIS. One credit hour. Electrical Engineering, fourth year, first semester. Prerequisites, Electrical Engineering 104 and 108. Professor CALDWELL, Associate Professor HUNT, Assistant Professor UPSON.

128. THESIS. Five credit hours. Electrical Engineering, fourth year, second semester. Professor CALDWELL, Associate Professor HUNT, Assistant Professor UPSON.

130. INSPECTION TRIP TO THE EAST. Given only in the even years. Electrical Engineering, third or fourth year.

Includes Pittsburg, Buffalo, Niagara, and Cleveland, and occupies six days at the end of the first semester. The entire expense need not exceed $32. A satisfactory written report is required.

132. INSPECTION TRIP TO THE WEST. Given only in the odd years. Electrical Engineering, third or fourth year.

Includes Chicago, Milwaukee, and Fort Wayne, and occupies six days at the end of the first semester. The entire expense need not exceed $32. A satisfactory written report is required.

134. READING COURSE. Electrical Engineering, third or fourth years. This may be taken as a substitute for Electrical Engineering 130 on presentation of reasons satisfactory to the head of the department.

Assigned reading on processes of manufacture and power plants.

136. READING COURSE. Electrical Engineering, third or fourth years. This may be taken as a substitute for Electrical Engineering 132 on presentation of reasons satisfactory to the head of the department.

## ENGINEERING DRAWING

(Office, Room 42, Brown Hall)

PROFESSOR FRENCH, ASSISTANT PROFESSOR MEIKLEJOHN, ASSISTANT PROFESSOR LEWIS, MR. WILLIAMS, MR. HARPER, MR. SHEETS, MR. NORRIS

Equivalent term courses: 101-102=1, 2, 3; 103=34, 35; 105=36; 106=35; 109=37; 111=5; 113=2a, 24, 25, 26; 114=38, 39; 122=21, 22.

101. ELEMENTARY MECHANICAL DRAWING. Two credit hours. All four-year courses, first year, first semester.

Practice in the use of drawing instruments, elementary projections.

102. MECHANICAL DRAWING. Three credit hours. All four-year courses, first year, second semester. Prerequisite, Drawing 101.

Lettering, orthographic, isometric, and oblique projections.

103. DESCRIPTIVE GEOMETRY. Three credit hours. Two recitations, two drawing periods weekly. Ceramic, chemical, electrical, industrial arts, mechanical and mining engineering, second year, first semester. Prerequisite, Drawing 102, or 114.

104. MACHINE SKETCHING. Three credit hours. One lecture, four drawing periods weekly. Ceramic, chemical, industrial arts, mechanical and mine engineering, second year, second semester. Prerequisite, Drawing 103.

105. DESCRIPTIVE GEOMETRY. Three credit hours. Two lectures,

two drawing periods weekly. Civil Engineering, second year, first semester. Prerequisite, Drawing 102.

106. ADVANCED DESCRIPTIVE GEOMETRY. Three credit hours. Two lectures, two drawing periods weekly. Civil Engineering, second year, second semester. Prerequisite, Drawing 105.

107. DESCRIPTIVE GEOMETRY. Three credit hours. Architecture, Summer Session after first year. Prerequisite, Drawing 102.

109. TECHNICAL SKETCHING. Two credit hours. Electrical Engineering, second year, first semester. Prerequisite, Drawing 102.

111. TECHNICAL DRAWING. Two credit hours. Mechanical and Electrical Engineering, third year, first semester. Prerequisite, Drawing 104, or 109.

113. FREE-HAND DRAWING AND LETTERING. Four credit hours. Short courses in Clay Working and Industrial Arts, first year, first semester. Short mining course, second year, first semester.

114. MECHANICAL DRAWING. Three credit hours. Clay Working, short Industrial Arts, first year, second semester. Short mining, second year, second semester. Prerequisite, Drawing 113.

115. CHARCOAL FROM ARCHITECTURAL ORNAMENT. Two credit hours. Architecture, second year, first semester.

116. PEN DRAWING. Two credit hours. Architecture, second year, second semester.

117. WATER COLOR. Three credit hours. Architecture, third year, first semester.

118. CHARCOAL DRAWING FROM THE ANTIQUE. Three credit hours. Architecture, third year, second semester. Prerequisite, Drawing 115.

119. CLAY MODELING. Two credit hours. Architecture, fourth year, first semester. Prerequisite, Drawing 115.

121. TECHNICAL DRAWING. Two credit hours. Designing of chemical plants, and machinery. Chemical Engineering, third year, first semester. Prerequisite, Drawing 104.

122. TECHNICAL DRAWING. Two credit hours. Continuation of 121. Chemical Engineering, third year, second semester.

## ENGLISH

(Office, Room 116, University Hall)

PROFESSORS DENNEY, TAYLOR, MCKNIGHT, ASSOCIATE PROFESSOR GRAVES, ASSISTANT PROFESSORS DUNCAN, BLANCHARD, LEIGHTON, COOPER, BURNHAM

Equivalent term courses: 101-104=1, 2, 3.

101. Paragraph Writing: Description and Narration. Two credit hours. First semester. (Course 101 will be repeated in the second semester as course 102 for the benefit of those who fail, the class meeting Saturdays at 9 a. m., Room 119.) All instructors.

104. Paragraph Writing: Exposition and Argumentation. Two credit hours. Second semester. Prerequisite, course 101. Same hours as for course 101. (Course 104 is also offered in the Summer.) All instructors.

## GEOLOGY

(Office, Room 1, Orton Hall)

PROFESSOR PROSSER, PROFESSOR BOWNOCKER, ASSISTANT PROFESSOR HUBBARD, MR. MORSE

Equivalent term courses: 162=1; 164=4; 165=2; 166=7; 167=6; 168=24.

162. Elementary Physiography. Four credit hours. Short mining, first year, second semester. Assistant Professor Hubbard.

The topographic features of the earth's surface and the agencies producing them. The atmosphere; the ocean. Rivers. Recitations, lectures, map work, and field work.

164. Elementary Geology. Three credit hours. Short mining, second year, second semester. Mr. Morse.

Lithological, dynamical, structural, and historical geology. Recitations, lectures, and laboratory work.

165. General Geology. Three credit hours. Mine Engineering, third year, first semester. Professor Prosser and Mr. Morse.

Structural, dynamical, and historical geology. The lectures are illustrated by maps, specimens, and lantern views. The common rock-forming minerals and rocks are studied in the laboratory. The first half of the semester, field trips Friday afternoon or Saturday morning will alternate with laboratory periods.

166. Petrography. Two credit hours. Mine Engineering, third year, second semester. Professor Bownocker.

A study of hand specimens of igneous, metamorphic, and sedimentary rocks, lectures and laboratory work.

167. ECONOMIC GEOLOGY. Three credit hours. Mine Engineering, fourth year, first semester. Prerequisites, Geology 165-166. Professor BOWNOCKER.

The nature and origin of ores; their modes of occurence and distribution. The non-metals, coal, oil, gas, clay, lime, cement, and building stones. In the discussion of the non-metals emphasis will be laid on the products of Ohio.

168. GENERAL GEOLOGY. Three credit hours. Ceramic Engineering, fourth year, Civil Engineering second year, second semester. Professor PROSSER, Assistant Professor HUBBARD, and Mr. MORSE.

Structural, dynamical, and historical geology. The lectures are illustrated by maps, specimens, and lantern views. The common rock-forming minerals and rocks are studied in the laboratory. The last half of the semester, field trips Friday afternoon or Saturday morning will alternate with laboratory periods.

## GERMANIC LANGUAGES AND LITERATURES

(Office, Room 317, University Hall)

PROFESSOR RHOADES, ASSOCIATE PROFESSOR EISENLOHR, ASSISTANT PROFESSOR THOMAS, ASSISTANT PROFESSORS BUSSE AND BARROWS, MR. BUSEY

Equivalent term courses: 101-102=1; 103-104=4; 106=2; 108=½ of 10.

101. ELEMENTARY GERMAN. Four credit hours. Four recitations weekly, first year, first semester. May be taken by students in any four-year course who enter with no entrance credits in German.

102. ELEMENTARY GERMAN. Continuation of German 101. Four credit hours, first year, second semester.

103. INTERMEDIATE GERMAN. Four credit hours. Four recitations weekly, first year, first semester. Prerequisite, German 102, or two units entrance credit.

106. SCIENCE READING. Four credit hours. Four recitations weekly, first year, second semester. Must be taken by students in Engineering who take German 103 the first semester. Prerequisite, German 103, or three units entrance credit.

107. RECENT FICTION AND PROSE COMPOSITION. Four credit hours. Four recitations weekly, first semester. May be taken by

first-year students in any four-year course who present four units entrance credits in German. Prerequisite, German 104 or 106.

108. MODERN DRAMA. Four credit hours. Second semester. Prerequisite, German 107 or 109.

109. HISTORICAL FICTION AND PROSE COMPOSITION. Four credit hours. Four recitations weekly, first year, first semester. May be taken by first-year students in any four-year course who present four units entrance credits in German. Prerequisite, German 104, 106, or four units entrance credit.

110. HISTORICAL DRAMA. Four credit hours. Second semester. Prerequisite, German 107 or 109.

## INDUSTRIAL ARTS

(Office, Room 2, Hayes Hall)

PROFESSOR SANBORN, ASSOCIATE PROFESSOR KNIGHT, MR. CROWE, MR. CASE, MR. BEEM, MR. DENMAN

Equivalent term courses: 101 or 102=1; 103 or 104=2; 105 or 106=3; 107 or 108=4; 110=8; 112=9; 114=5.

### INDUSTRIAL ARTS

101. TOOLS AND MACHINES. Three credit hours. Three recitations weekly. Industrial Arts, third year. Short Industrial Arts, second year, first semester. Prerequisite, Mathematics 114 or 132, Concurrent Physics 101. Professor SANBORN.

Principles underlying the construction and operations of machines with a special study of machine tools.

102. Continuation of 101. Three credit hours. Three recitations weekly. Short Industrial Arts, second year, Industrial Arts, third year, second semester. Professor SANBORN.

103. DESIGNING. Two credit hours. Two three-hour laboratory periods weekly. Industrial Arts, third year, Short Industrial Arts, second year, first semester. Concurrent, Industrial Arts 101. Professor SANBORN.

104. Continuation of 103. Two credit hours. Two three-hour laboratory periods weekly. Industrial Arts, third year, Short Industrial Arts, second year, second semester. Concurrent, Industrial Arts 102. Professor SANBORN.

105. SHOP CONSTRUCTION AND EQUIPMENT. Three credit hours. Three recitations weekly. Industrial Arts, fourth year, first semes-

ter. Prerequisite, Industrial Arts 102. Concurrent, Industrial Arts 103. Professor SANBORN.

Strength and durability of the materials used in construction; shop and factory buildings and their construction; power, power transmission, and prime movers.

106. Continuation of 105. Three credit hours. Three recitations weekly. Industrial Arts, fourth year, second semester. Concurrent, Industrial Arts 104. Professor SANBORN.

107. ADVANCED DESIGNING. Three credit hours. Two three-hour laboratory periods weekly. Industrial Arts, fourth year, first semester. Prerequisite, Engineering Drawing 104. Concurrent, Industrial Arts 105. Professor SANBORN.

Graphical problems in construction, design of building, arrangement of machinery, line shafting, etc.

108. Continuation of 107. Three credit hours. Two three-hour laboratory periods weekly. Industrial Arts, fourth year, second semester. Concurrent, Industrial Arts 106. Professor SANBORN.

110. STRENGTH OF MATERIALS. Six credit hours. Five recitations and one three-hour laboratory period weekly. Short Industrial Arts, second year, second semester. Professor SANBORN.

Study and strength of properties of materials and their use in machines.

112. MACHINE DESIGN. Two credit hours. Two two-hour drawing periods weekly. Electrical Engineering, fourth year, second semester. Prerequisite, Mechanics 102, and Engineering Drawing 111. Professor SANBORN.

Practical application of principles of machine design.

114. SHOP BUILDING. Two credit hours. Two recitations weekly. Alternative with Mechanical Engineering 146, fourth year, second semester. Prerequisite, Civil Engineering 126. Professor SANBORN.

Lectures and problems on the construction of shop building and the arrangement of machinery; special shop appliances.

### SHOPWORK

Equivalent term courses: 105 or 106=3; 107 or 108=4; 109 or 110=7; 111 or 112=9; 113 or 114=8; 115 or 116=11; 118=12; 119 or 120=13, ½ of 14; 121 or 122=½ of 14, 15; 123=16, ½ of 17.

105. FOUNDRY WORK. One and two-thirds credit hours. One recitation and one three-hour laboratory weekly. Mechanical Engineering, second year, first semester. Mr. BEEM.

Exercises and practice on tempering sand and preparing molds of machine parts in sand, core-making, melting iron and brass, and pouring.

106. Repetition of 105. Short Industrial Arts, first year, second semester. Two credit hours, Industrial Arts, second year, second semester. Mr. BEEM.

107. CHIPPING AND FILING. One and one-third credit hours. Two two-hour laboratory periods weekly. Mechanical Engineering, second year, first semester. Ceramic Engineering, alternative with 109 and 115, and Industrial Arts during the Summer Session at close of first year. Associate Professor KNIGHT, Mr. CASE.

Exercises and practice in vise work including chipping in cast, and wrought iron, surface filing, squaring, fitting, finishing, and the scraping of surface plates.

108. Repetition of 107. Short Industrial Arts, first year, second semester. Associate Professor KNIGHT, Mr. CASE.

109. JOINERY AND PATTERN MAKING. Two credit hours. One recitation and two two-hour laboratory periods weekly. Short Industrial Arts, first year, first semester. Ceramic Engineering, Short Clay-working, alternative with Shopwork 107 and 115; Chemical Engineering, Electrical Engineering, Industrial Arts, Mechanical Engineering, and Mine Engineering during the Summer Session at the close of first year. Mr. BEEM, Mr. DENMAN.

Exercises and practice in joinery, wood-turning, and pattern-making, including sawing, planing, mortising, framing, and other work involving the use of the ordinary carpenter tools; center and chuck turning, and the making of finished patterns.

111. ADVANCED PATTERN-MAKING. Two credit hours. One recitation and two two-hour laboratory periods weekly. Mechanical Engineering, second year, first semester. Prerequisite, Shopwork 109. Mr. BEEM, Mr. DENMAN.

112. Repetition of 111. Industrial Arts and Short Industrial Arts, first year, second semester. Mr. BEEM, Mr. DENMAN.

113. CABINET-MAKING. Two credit hours. Two three-hour laboratory periods weekly. Elective, first semester. Prerequisite, Shopwork 109 or 110. Mr. BEEM, Mr. DENMAN.

Exercises and practice in cabinet-making, including paneling, mitre and dove-tail joints; use of power tools.

114. Repetition of 113. Elective, second semester.

115. FORGING. Two credit hours. One recitation and two two-

hour laboratory periods weekly. Industrial Arts and Short Industrial Arts, second year, first semester. Ceramic, Chemical, Electrical, Mechanical, and Mine Engineering, and Short Clay Working, during the summer sessions at the close of first year. Mr. CROWE.

The use and care of forge, fire, and tools. Practice in iron and steel forging, including such operations as cutting, bending, drawing, upsetting, shaping and welding iron; the making, hardening and tempering of steel punches, chisels, and lathe tools.

116. Repetition of 115. Short Mining, first year, second semester.

118. ADVANCED FORGING. Two credit hours. Two three-hour laboratory periods weekly. Elective, second semester. Prerequisite, Shopwork 115. Mr. CROWE.

Various forms of welds in iron and steel; the use of scrolling irons and of forms for duplicating work; annealing; tool-making; case-hardening; tempering drills, dies and cutters; spring-making; ornamental iron work; visits to shops.

119. MACHINE WORK. Three credit hours. One recitation and two three-hour laboratory periods weekly. Electrical Engineering and Short Industrial Arts, second year, first semester. Industrial Arts, third year, first semester. Associate Professor KNIGHT, Mr. CASE.

Elementary exercises on the engine lathe, such as plain, straight, and taper turning, screw cutting, chucking, boring, filing and polishing, and the use of the drill press.

120. Repetition of 119. Mechanical Engineering, second year, second semester. Associate Professor KNIGHT, Mr. CASE.

121. ADVANCED MACHINE WORK. Three credit hours. One recitation and two three-hour laboratory periods weekly. Mechanical Engineering, third year, first semester. Prerequisite, Shopwork 119 or 120. Associate Professor KNIGHT.

A continuation of course 119 or 120 with more difficult exercises in the lathe, including square thread cutting, drilling, and tapping, use of steady rest, face plate work and bar turning. Also practice on the milling machines, planer, shaper and turret lathe.

122. Repetition of 121. Industrial Arts, third year, second semester. Short Industrial Arts and Electrical Engineering, second year, second semester. Associate Professor KNIGHT.

123. ADVANCED MACHINE WORK. Two credit hours. Two three-hour laboratory periods weekly. Industrial Arts, fourth year,

first semester. Prerequisite, Shopwork 121 or 122. Associate Professor KNIGHT.

A more advanced course in milling machine work and grinding. Exercises in spur and spiral gear cutting, cam cutting, and differential and fractional indexing.

125. CONSTRUCTION WORK. Two credit hours. First semester. Two three-hour laboratory periods weekly. Elective. Prerequisite, Shopwork 121 or 122. Associate Professor KNIGHT.

A course in construction work on any piece of apparatus or machinery which may be in course of construction in the shops.

126. Repetition of 125. Second semester. Elective.

127. TOOL-MAKING AND JIG WORK. Three credit hours. First semester. Elective. Prerequisite, Shopwork 123. Associate Professor KNIGHT.

128. Repetition of 127. Three credit hours. Elective, second semester.

### SUMMER SESSION

The Summer Session in Shopwork will begin on Monday preceding Commencement Day and will continue for four weeks. The courses open to students are 107, 109, 115, and 119 or 120. Each course requires attendance six days a week. Students electing Electrical Engineering, Mechanical Engineering, Mine Engineering, and Short Clay-working are required to take Shopwork 109 and 115 at the close of their first year. Students electing Chemical Engineering are required to take Shopwork 109 and 115 during the Summer Session at the close of the first year or second year.

Students in Industrial Arts are required to take Shopwork 107 and 109 at the close of first year, and students electing Ceramic Engineering are required to take two of the three following subjects at the close of the first year: Shopwork 107, 109, and 115.

## MATHEMATICS

(Office, Room 314, University Hall)

PROFESSOR BOHANNAN, PROFESSOR MCCOARD, PROFESSOR SWARTZEL, PROFESSOR KUHN, ASSOCIATE PROFESSOR ARNOLD, ASSOCIATE PROFESSOR RASOR, ASSISTANT PROFESSOR PRESTON, ASSISTANT PROFESSOR BAREIS, ASSISTANT PROFESSOR MORRIS, MISS RICKARD

Equivalent term courses: 101-102=1, 2; 113-114=3, 3a, 13, 14; 131-132=31, 32, 33; 141-142=41, 42, 43; 151=11; 169=74.

101. ELEMENTARY ALGEBRA. Five credit hours. Five recitations weekly. Short Clay-working, Short Industrial Arts, and Short Mining, first year, first semester. Text-book: Wentworth's Algebra.

102. Continuation of 101. Five credit hours. Five recitations weekly. Short Clay-working, Short Industrial Arts, and Short Mining, first year, second semester. Prerequisite, Mathematics 101.

113. PLANE AND SOLID GEOMETRY. Five credit hours. Five recitations weekly. Short Clay-working, Short Industrial Arts, and Short Mining, first year, first semester. Text-book: Venable's Geometry.

114. SOLID GEOMETRY AND PLANE TRIGONOMETRY. Five credit hours. Five recitations weekly. Short Clay-working, Short Industrial Arts, and Short Mining, first year, second semester. Prerequisite, Mathematics 113. Text-books: Venable's Geometry, and Bohannan's Trigonometry.

131. COLLEGE ALGEBRA AND TRIGONOMETRY. Five credit hours. Five recitations weekly. All four-year courses in Engineering, first year, first semester. Prerequisites, Entrance Algebra and Geometry. Text-books: Rietz and Crathome's College Algebra, and Bohannan's Trigonometry.

This course is repeated in the second semester for the benefit of the students who fail in the first semester.

132. TRIGONOMETRY AND ANALYTICAL GEOMETRY. Five credit hours. Five recitations weekly. All four-year courses in Engineering, first year, second semester. Prerequisite, Mathematics 131. Text-books: Bohannan's Trigonometry, Fine and Thompson's Analytical Geometry.

This course is repeated in the Summer Session.

141. CALCULUS. Five credit hours. Five recitations weekly. All four-year courses in Engineering, second year, first semester. Prerequisite, Mathematics 132. Text-book: Osgood's Calculus.

142. Continuation of 141. Five credit hours. Five recitations weekly. All four-year courses in Engineering, except Industrial Arts, second year, second semester. Prerequisite, Mathematics 141.

151. DIFFERENTIAL EQUATIONS. One credit hour. One recitation weekly. Mechanical Engineering, third year, first semester. Prerequisite, Mathematics 142. Text-book: Boyd's Differential Equations.

169. DIFFERENTIAL EQUATIONS. Two credit hours. Two recitations weekly. Elective, first semester. Prerequisite, Mathematics 142. Text-book: Boyd's Differential Equations.

HIGHER MATHEMATICS. Elective. See bulletin of the College of Arts, Philosophy, and Science for special courses.

## MECHANICAL ENGINEERING

(Office, Room 244, Engineering Laboratory)

PROFESSOR MAGRUDER, PROFESSOR HITCHCOCK, ASSOCIATE PROFESSOR JUDD, ASSISTANT PROFESSOR PACKARD, MR. VALLANCE

Equivalent term courses: 101=37; 103=32; 110=43; 114=3; 121=42; 114-116=3; 118=33; 121=42; 123=23; 125-129=34; 127=18; 131=38; 133=39; 135=40; 137=41; 140=44; 142=31; 144=18, 19; 146=45; 148=21; 160=28, 29; 162=12, 29; 164=12, 27; 171=36; 173=46, 47; 175-177=29, 30; 179=27; 190=14, 15; 192=36.

101. Mechanism. Three credit hours. Three recitations weekly. Electrical Engineering, third year, first semester. Prerequisites, Engineering Drawing 103, and Physics 114. Associate Professor Judd, and Assistant Professor Packard.

Recitations on the principles of mechanism and mechanical movements.

103. Steam Power Plants. Three credit hours. Three recitations weekly. Chemical, Electrical, and Mechanical Engineering, and Industrial Arts, third year, first semester. Prerequisites, Engineering Drawing 104 and Physics 112, or Industrial Arts 102. Professor Magruder, and Assistant Professor Packard.

A descriptive study of steam-generating and steam-using machinery.

110. Mechanism and Machine Design. Three credit hours. Three recitations weekly. Ceramic Engineering, third year, second semester. Prerequisite, Drawing 104, Physics 112, and Mechanics 101. Associate Professor Judd.

Recitations on the principles of mechanism, mechanical movements, and elementary machine design.

114. Mechanism. Three credit hours. Three recitations weekly. Mechanical Engineering, third year, second semester. Prerequisite, Drawing 104, and Physics 112. Professor Hitchcock.

Recitations and practice on the principles of mechanism and mechanical movements.

116. Mechanism Drawing. One credit hour. One three-hour drawing period weekly. Mechanical Engineering, third year, second semester. Prerequisite or concurrent, Mechanical Engineering 114. Professor Hitchcock.

Practice in laying out mechanisms and mechanical movements.

118. Steam Engines and Boilers. Four credit hours. Four recitations weekly. Electrical and Mechanical Engineering, and In-

dustrial Arts, third year, second semester. Prerequisites, Mechanical Engineering 103 and Mechanics 101. Professor MAGRUDER.

118. STEAM ENGINES AND BOILERS. Three credit hours. Three recitations weekly. Electrical and Mechanical Engineering, and Industrial Arts, fourth year, first semester, 1910-11, only.

A detailed study of steam-generating and steam-using machinery.

121. HEATING AND VENTILATING. Two credit hours. Two recitations weekly. Architecture, fourth year, first semester. Prerequisite, Mechanics 101. Professor HITCHCOCK.

Recitations and lectures on the principles and methods of heating and ventilation, with laboratory work and investigations of the heating and ventilating plants of different buildings.

123. MATERIALS OF CONSTRUCTION. Two credit hours. One recitation and one three-hour laboratory period weekly. Required in Architecture, fourth year, first semester. Prerequisite, Mechanics 101. Associate Professor JUDD.

Lectures and recitations on the materials used in architectural and building construction, and laboratory exercises on their properties.

125. GAS ENGINES AND PRODUCERS. Two credit hours. Two recitations weekly. Required in Mechanical Engineering, fourth year, first semester. Prerequisite, Mechanical Engineering 118. Professor MAGRUDER.

A study of gas engines and of gas-producers as used for power purposes.

127. MACHINE DESIGN. Five credit hours. Five recitations weekly. Required in Chemical and Mechanical Engineering, fourth year, first semester. Prerequisites, Drawing 104 and 111, Mechanics 102, and Metallurgy 109. Professor MAGRUDER.

A detailed course of study based upon mechanics and the materials of construction as purchased applied to the design and construction of machinery.

129. THERMODYNAMICS. Two credit hours. Two recitations weekly. Required in Mechanical Engineering, fourth year, first semester. Prerequisite, Mechanical Engineering 118. Professor MAGRUDER.

The transmutations of heat and mechanical energies in steam and air engines, in air and ammonia compressors, and in refrigeration machines, together with a study of the tests of ideal and actual engines, and of their indicator diagrams; the flow of gases through pipes and orifices.

131. INSPECTION TRIP TO THE EAST. One week at end of first semester, third or fourth years. Required in Mechanical Engineering. Prerequisite, Mechanical Engineering 103.

Given only in the even years.

Includes Pittsburg, Buffalo, Niagara Falls, Cleveland, and possibly other places. The entire expense need not exceed $32. A satisfactory written report upon the work of the trip is required.

133. INSPECTION TRIP TO THE WEST. One week at end of first semester, third or fourth years. Required in Mechanical Engineering. Prerequisite, Mechanical Engineering 103.

Given only in the odd years.

Includes Chicago, Milwaukee, Gary, and possibly other places. The entire expense need not exceed $32. A satisfactory written report upon the work of the trip is required.

135. WRITTEN REPORT. Course of assigned reading upon processes of manufacture and power plants taken and reported upon by third and fourth year students in Mechanical Engineering as a substitute for Mechanical Engineering 131 on presentation of reasons satisfactory to the head of the department. One week at end of first semester, third or fourth years. Required in Mechanical Engineering.

137. WRITTEN REPORT. Similar to Mechanical Engineering 135, as a substitute for Mechanical Engineering 133. One week at end of first semester, third or fourth years. Required in Mechanical Engineering.

140. MECHANISM AND MACHINE DESIGN. Two credit hours. Two recitations weekly. Required in Civil Engineering, fourth year, second semester. Prerequisite, Mechanics 101. Professor MAGRUDER.

An elementary course in the principles of mechanism and mechanical movements and the design of parts of machines.

142. HYDRAULIC MACHINERY. Two credit hours. Two recitations weekly. Required in Mechanical Engineering, fourth year. second semester. Prerequisite, Mechanics 102, and Mechanical Engineering 106. Professor HITCHCOCK.

A study of pumping machinery.

144. MACHINE DESIGN. Five credit hours. Three recitations and two three-hour drawing periods weekly. Required in Chemical

and Mechanical Engineering, fourth year, second semester. Prerequisite, Mechanical Engineering 127. Professor MAGRUDER.

A continuation of course 127, with practical applications on the drawing board of the principles to the design of some particular machine.

146. STEAM TURBINES. Two credit hours. Two recitations weekly. Optional in Mechanical Engineering with Industrial Arts 114, fourth year, second semester. Prerequisite, Mechanical Engineering 129. Professor HITCHCOCK.

A study of the generation of power by steam turbines, including auxiliary machinery.

148. THESIS WORK. Three credit hours. Required in Mechanical Engineering, fourth year, second semester. Prerequisite, Mechanical Engineering 127 or 129. Professor MAGRUDER, or Professor HITCHCOCK.

A special investigation or design based upon the work of the course.

160. EXPERIMENTAL ENGINEERING LABORATORY. Two credit hours. One four-hour laboratory period weekly. Required in Electrical Engineering, third year, second semester. Concurrent, Mechanics 102, and Mechanical Engineering 118. Associate Professor JUDD, and Assistant Professor PACKARD.

Calibration of pressure gauges and indicator springs, steam engine indicator practice, testing of lubricating oils, and the materials of construction.

162. EXPERIMENTAL ENGINEERING LABORATORY. Two credit hours. One four-hour laboratory period weekly. Required in Industrial Arts, third year, second semester. Prerequisites, Drawing 104, and Physics 114. Associate Professor JUDD, and Assistant Professor PACKARD.

Calibration of pressure gauges and indicator springs; steam engine indicator practice; testing of lubricating oils and the materials of construction.

164. EXPERIMENTAL ENGINEERING LABORATORY. Two credit hours. One four-year laboratory period weekly. Required in Mechanical Engineering, third year, second semester. Concurrent, Mechanics 102, and Mechanical Engineering 118. Associate Professor JUDD.

Calibration of pressure gauges and indicator springs; steam engine indicator practice; testing of oils and the materials of construction.

171. EXPERIMENTAL ENGINEERING LABORATORY. Four credit hours. Two recitations weekly and one four-hour laboratory period weekly. Required in Ceramic Engineering, fourth year, first semester. Prerequisites, Mechanics 102, and Metallurgy 109. Professor HITCHCOCK, Associate Professor JUDD, and Assistant Professor PACKARD.

Lectures and recitations on power transmission, steam and gas engines, and boilers. Laboratory work in the calibration of pressure gauges and indicator springs; valve setting; testing of steam and gas engines; testing of steam and centrifugal pumps; boiler and fuel trials.

173. EXPERIMENTAL ENGINEERING LABORATORY. Five credit hours. One recitation weekly and two four-hour laboratory periods weekly. Required in Civil Engineering, fourth year, first semester. Prerequisite, Mechanics 102. Professor HITCHCOCK, Associate Professor JUDD, and Assistant Professor PACKARD.

Practice in the testing of the materials of construction; calibration of orifices and weirs; study of the flow of liquids and gases; tests of steam, power, rotary, and centrifugal pumps; tests of water motors and turbine water wheels. Lectures and recitations on same and on steam engines, boilers, and transmission machinery.

175. EXPERIMENTAL ENGINEERING LABORATORY. Three credit hours. One six-hour laboratory period weekly. Required in Electrical Engineering, fourth year, first semester. Prerequisite, Mechanical Engineering 160. Associate Professor JUDD, and Assistant Professor PACKARD.

Tests of steam engines and boilers; gas and oil engines, steam and power pumps; hydraulic experimentation; and the use of transmission and absorption dynamometers.

177. EXPERIMENTAL ENGINEERING LABORATORY. Two credit hours. One four-hour laboratory period weekly. Required in Industrial Arts, fourth year, first semester. Prerequisite, Mechanical Engineering 162. Associate Professor JUDD, and Assistant Professor PACKARD.

Tests of steam engines and boilers, gas and oil engines, steam and power pumps; and the use of transmission and absorption dynamometers.

179. EXPERIMENTAL ENGINEERING LABORATORY. Two credit hours. One four-hour laboratory period weekly. Required in Mechanical Engineering fourth year, first semester. Prerequisite, Mechanical Engineering 164. Concurrent, Mechanical Engineering

125 and 129. Professor HITCHCOCK, Associate Professor JUDD, and Assistant Professor PACKARD.

Valve setting, moisture determinations in steam, gas calorimetry, measurements of flow of water by means of orifices, nozzles, weirs, and venturi-meter; tests of belts with use of transmission and absorption dynamometers.

190. EXPERIMENTAL ENGINEERING LABORATORY. Six credit hours. Four three-hour laboratory periods weekly. Required in Mechanical Engineering, fourth year, second semester. Prerequisites, Mechanical Engineering 125, 129, and 179. Professor HITCHCOCK, Associate Professor JUDD, and Assistant Professor PACKARD.

Tests of steam and hot air engines; steam boilers; gas and oil engines; gas producers; air compressors; injectors and pulsometers; centrifugal, rotary, and power pumps; hydraulic rams, impulse and turbine water wheels; fans and blowers.

192. EXPERIMENTAL ENGINEERING LABORATORY. Three credit hours. One recitation weekly and one four-hour laboratory period weekly. Required in Mine Engineering, fourth year, second semester. Prerequisites, Mechanics 102, and Metallurgy 109. Professor HITCHCOCK, Associate Professor JUDD, and Assistant Professor PACKARD.

Lectures and recitations on power transmission, steam and gas engines, steam boilers, and gas producers. Laboratory work in the calibration of pressure gauges and indicator springs; valve setting; testing of steam engines; testing of steam and centrifugal pumps; boiler and fuel trials; tests of gas engines and gas producers.

## MECHANICS

(Office, Room 233, Mines Building)

PROFESSOR J. E. BOYD, ASSOCIATE PROFESSOR CODDINGTON, MR. BORN

Equivalent term courses: 101-102=1, 2, 3; 101-104=1, 2.

101. STATICS AND STRENGTH OF MATERIALS. Five credit hours. Architecture, Ceramic, Chemical, Civil, Electrical, Mechanical and Mine Engineering, third year, first semester. Prerequisite, Mathematics 142. Professor J. E. BOYD, Associate Professor CODDINGTON.

102. STRENGTH OF MATERIALS Continued. Kinetics and Hydraulics. Five credit hours. Chemical, Civil, Electrical, Mechanical and Mine Engineering, third year, second semester. Prerequisite, Mechanics 101. Professor J. E. BOYD, Associate Professor CODDINGTON.

104. Strength of Materials. Two credit hours. Architecture and Ceramic Engineering, third year, second semester. Prerequisite, Mechanics 101.

## METALLURGY AND MINERALOGY

(Office, Room 100, Mines Building)

PROFESSOR N. W. LORD, ASSOCIATE PROFESSOR SOMERMEIER, ASSISTANT PROFESSOR DEMOREST

Equivalent term courses: 102=9; 104=2; 105=6; 106=5; 108=3; 109=4; 111=7; 113=8; 114=11.

102. Mineral Chemistry. Four credit hours. Short Mining second year, second semester. Prerequisite, Chemistry 101. Professor Lord.

A course of lectures upon mine gases, safety lamps, mine explosions, boiler water, mine water, water supply, explosives, coal and coke.

104. Crystallography and Mineralogy. Two credit hours. Mine Engineering, second year, and Chemical Engineering, third year, second semester. Prerequisite, Chemistry 106. Two lecture hours. Professor Lord.

Lectures on Crystallography and Physical Mineralogy. Illustrated by drawings and models.

105. Fire Assaying. Three credit hours. Mine Engineering, third year, first semester. Laboratory, two afternoons per week. Monday and Tuesday, or Thursday and Friday. Prerequisite, Metallurgy 106, or equivalent. Associate Professor Somermeier.

Lectures and laboratory work. Practical work in the assaying of gold, silver, and lead ores.

106. Metallurgical Analysis. Four credit hours. Mine Engineering, second year, second semester. Prerequisite, Chemistry 106 or 110, and Chemistry 119. Assistant Professor Demorest.

Lectures and laboratory work. Laboratory work in the analysis of iron ores, iron and steel, fuel and slags, and ores of lead, zinc, and copper by wet methods, using approved methods as practiced in technical laboratories and metallurgical works.

107. Alloy Analysis. Four credit hours. Mine Engineering, third year, first semester. Prerequisite, Metallurgy 106. Assistant Professor Demorest.

Lectures and laboratory work. Laboratory work in the analysis of alloy steels, such as vanadium, tungsten, chromium, nickel and molybdenum steels, and other alloys. Quantitative work preceded by qualitative tests on the alloys.

108. DETERMINATIVE MINERALOGY. Three credit hours. Two three-hour laboratory periods weekly. Mine Engineering, third year, second semester. Prerequisite, Metallurgy 104. Professor LORD, Assistant Professor DEMOREST.

Lectures and laboratory work in practical determination of minerals by physical and chemical tests. Each student is furnished with a set of apparatus and works under an instructor's inspection. Brush and Penfield's Determinative Mineralogy is used as a manual.

109. GENERAL METALLURGY. Four credit hours. Mine Engineering, Industrial Arts, Mechanical Engineering, Chemical Engineering, third year, first semester; Ceramic Engineering, fourth year, first semester. Prerequisites, Chemistry 106, and Physics 114. Three lectures, one section; and two recitations in two sections. Professor LORD.

Lectures and recitations on general metallurgy, fuels, iron and steel, their properties and manufacture.

110. METALLURGY OF NON-FERROUS METALS. Four credit hours. Mine Engineering, third year, second semester. Three lectures, two recitations. Professor LORD.

Lectures and recitations on the metallurgy of the non-ferrous metals, copper, lead, gold, silver, etc. The properties, reduction, and purification.

111. METALLURGICAL CONSTRUCTION. Two credit hours. Mine Engineering, fourth year, first semester. Prerequisites, Drawing 111, Mechanics 102, Metallurgy 109 and 113. Professor LORD, Professor RAY.

Lectures and drawing room practice on the designing of furnaces and metallurgical plants.

112. TECHNICAL GAS ANALYSIS. Two credit hours. Mine Engineering, third year, second semester. Two afternoons per week. Prerequisites, Metallurgy 106, 107, 109, and 110, or equivalent. Professor SOMERMEIER.

Laboratory work supplemented by lectures. Technical analysis of metallurgical and mine gases. Determination of the calorific value of gases; problems involving application of results of gas analysis to furnace operation, mine ventilation, etc.

113. ORE DRESSING AND COAL WASHING. Two credit hours. Mine Engineering, fourth year, first semester. Prerequisite, Metallurgy 109. Professor LORD.

Methods of concentrating and enriching ores and fuels by mechanical means. Lectures with references to standard books and various papers in technical journals.

114. Special Metallurgy. Three credit hours. Mine Engineering, fourth year, second semester. Hours to be arranged. Prerequisites, Metallurgy 106, 107, 109, 110, or equivalent. Professor Lord and Professor Somermeier.

Lectures and laboratory, supplemented by lectures on mine gases and waters, safety appliances, explosives, microscopic examination of metals, study of properties of alloys, testing of metallurgical processes, pyrometry and high temperature measurements, calorimetry, and other tests on fuels.

## MILITARY SCIENCE AND TACTICS

(Office, The Armory)

CAPTAIN GEORGE L. CONVERSE, U. S. A., RETIRED

The Military Department is open five days during each week throughout the year. The work is required of all students during the first and second years, unless excused by the Military and Gymnasium Board.

Military Drill. One credit hour. Three hours drill or three recitations in tactics weekly, first and second years.

## MINE ENGINEERING

(Office, Room 200, Mines Building)

PROFESSOR RAY, ASSISTANT PROFESSOR MINOR

Equivalent term courses: 101-102=1, 2, 3; 104=6; 105-106=5; 107=7.

101. Mine Engineering. Five credit hours. Lectures and field practice. Short Mining, second year, first semester. Prerequisite, Mathematics 114.

102. Mine Engineering. Five credit hours. Short Mining, second year, second semester. Prerequisite, Mine Engineering 101, and Physics 101.

Lectures illustrated by experiments and maps of mines and models, tests of safety lamps and anemometers, methods of air distribution in coal mines.

103. Mine Surveying. Five credit hours. Mine Engineering, second year, first semester, and Ceramic Engineering, third year,

first semester. Prerequisites, Engineering Drawing 104, and Mathematics 132.

Field practice in the use of instruments for surface and underground surveys. Full notes are taken and maps and plans made in the drawing room.

104. PLANS AND SPECIFICATIONS. Four credit hours. Two lectures and two three-hour drawing periods. Mine Engineering, fourth year, second semester. Prerequisites, Metallurgy 111, and Mine Engineering 105.

Practice in designing mine plans, drafting and estimating.

105. MINE ENGINEERING. Five credit hours. Five lectures weekly. Mine Engineering, fourth year, first semester. Prerequisites, Mechanics 102, Mine Engineering 103, and Geology 165.

Mine operating, mining machinery, ventilation, shaft-sinking, workout deposits, etc., with constant reference to technical journals.

106. MINE ENGINEERING. Five credit hours. Five lectures weekly. Mine Engineering, fourth year, second semester. Prerequisite, Mine Engineering 105.

A continuation of Mine Engineering 105.

107. MINE PLANS. Two credit hours. Two two-hour drawing periods weekly. Short Mining, second year, first semester.

## PHYSICAL EDUCATION FOR MEN

(The Gymnasium)

PROFESSOR WINGERT, MR. KIBLER, MR. BAUER

1. PHYSICAL EDUCATION. Two hours per week. One credit hour. The year. (a) Lectures on hygiene and physiology of exercise, first two weeks, first semester. (b) Corrective: A graded course of free-hand exercise stretching, relaxing, stimulating, exercise with light hand apparatus for the relief and correction of slight body defects, deformities, improper carriage, etc. (c) Educative: Graded progressive exercise on the apparatus and mats to promote muscular tone, vigor, vitality, endurance. (d) Recreative: Gymnasium games, mental relaxation, non-competitive exercises. (e) Ability to swim is required and free instruction is given to those who cannot swim.

2. ADVANCED EXERCISES. Elective. (a) Advanced exercises on the apparatus and mats. (b) Combatative exercises—boxing, fencing, wrestling. A small charge is made to those electing this work

(c) Recreative: Football, baseball, basketball, tennis, track and field sport, cross-country running, etc. Special hours are arranged for those electing the above exercise and credit given in regular course.

## PHYSICS

(Office, Room 24, Physics Building)

PROFESSOR COLE, PROFESSOR THOMAS, ASSOCIATE PROFESSOR EARHART, ASSISTANT PROFESSOR BLAKE, ASSISTANT PROFESSOR SMITH, ASSISTANT PROFESSOR SHEARD, MR. HEIL, MR. BARNES, MR. NUSBAUM, AND DEPARTMENT FELLOWS

**Equivalent term courses: 101=1; 111-112=2; 113-114=31, 32; 134=5; 135=6; 137-138=7; 139-140=9.**

101. ELEMENTARY PHYSICS. Six credit hours. Five recitations and lectures. One three-hour laboratory period weekly. Short Clay-working and Industrial Arts, second year, first semester. Short Mining, first year, first semester. Associate Professor EARHART. Text-book: Millikin and Gale's Elements of Physics.

111. GENERAL PHYSICS. Three credit hours. Two lectures, one recitation, and one two-hour laboratory period weekly. Architecture, Chemical, Civil, and Mine Engineering, second year, first semester. Prerequisites, Preparatory Physics and Mathematics 132. Professor COLE, Mr. HEIL, and others.

112. Continuation of Physics 111. Three credit hours. Two lectures, one quiz, and one two-hour laboratory period weekly. Chemical, Civil, Mine, and Mechanical Engineering. Prerequisite, Physics 111. Professor COLE, Mr. HEIL.

113. GENERAL PHYSICS. Mechanics and Heat. Five credit hours. Two lectures, three recitations, and one two-hour laboratory period weekly. Ceramic, Electrical, and Mechanical Engineering, and Industrial Arts, second year, first semester. Prerequisites, preparatory Physics and Mathematics 132. Professor COLE, Mr. HEIL, and others.

114. GENERAL PHYSICS. Electricity, Light and Sound. A continuation of Physics 113. Five credit hours. Two lectures, three recitations, and one two-hour laboratory period weekly. Ceramic, Electrical, and Industrial Arts, second year, second semester. Prerequisite, Physics 113. Professor COLE, Mr. HEIL, and others.

134. PHYSICAL LABORATORY. Five credit hours. Three three-hour laboratory periods weekly. Electrical Engineering, second year,

second semester. Prerequisites, Physics 113, Concurrent Physics 114. Professor THOMAS, Mr. BARNES.

135. PHYSICAL LABORATORY. Five credit hours. Three three-hour laboratory periods weekly. Electrical Engineering, third year, first semester. Prerequisites, Physics 114 and 134. Professor THOMAS, Mr. BARNES.

Theory and practice of magnetic and electrical measurement, including the testing and standardizing of instruments; conductivity of conductors; insulation, capacity, and resistance of insulated conductors and cables; temperature co-efficients; commercial measuring and testing instruments; strength and distribution of magnetic fields; magnetic moments; permeability; photometry of gas, electric, and other lights.

137. PHYSICAL LABORATORY. Three to five credit hours. Prerequisite or Concurrent Physics 111.

138. PHYSICAL LABORATORY. Two credit hours. Two two-hour laboratory periods weekly. Mechanical Engineering, second year, second semester. Prerequisites, Physics 111, Concurrent 112, three to five credit hours. Elective. Prerequisite, 111 or Concurrent 112.

139. PHYSICAL LABORATORY. Three to five credit hours. A second year's work in Physical Laboratory. Elective, first semester. Prerequisite, Physics 138, or equivalent.

140. PHYSICAL LABORATORY. Three to five credit hours. A continuation of Physics 139. Elective, second semester.

## ROMANCE LANGUAGES AND LITERATURES

(Office, Room 305, University Hall)

PROFESSOR BOWEN, PROFESSOR BRUCE, ASSOCIATE PROFESSOR INGRAHAM, ASSISTANT PROFESSOR PEIRCE, ASSISTANT PROFESSOR HAMILTON, DR. FALORSI

Equivalent term courses: 101-102=1; 103=2; 106=3.

101-102. ELEMENTARY FRENCH. Four credit hours. The year. Four recitations weekly, first year. May be taken by students in any four-year course who enter with no entrance credits in French. Text-books: Thieme and Effinger's Grammar, and Aldrich and Foster's or Bowen's First Scientific Reader. All instructors.

103. MODERN FRENCH LITERATURE. Four credit hours. Four recitations weekly, first year, first semester. May be taken by first-year students in any four-year course who enter with two units en-

trance credits in French. Prerequisite, French 101-102, or two units entrance credits. Professor Bruce, Assistant Professor Peirce, Assistant Professor Hamilton.

Nineteenth Century Prose, including (1) Contes, (2) the novel (Balzac or Hugo). Prose Composition. Systematic attention given to Syntax and Idiom.

106. Science Reading. Four credit hours. Four recitations weekly, first year, second semester. Must be taken by students in Engineering who take French 103 during the first semester.

### SPANISH

**Equivalent term courses: 101-102=1; 103-104=2.**

101-102. Elementary Spanish. Four credit hours. The year. Four recitations weekly, first year. May be taken by students in any four-year course who enter with no entrance credits in Spanish. Grammar (Hills & Ford's), and Ingraham's Victoria y Otros Cuentos. Easy Prose and Plays. Composition and Practice in speaking. Associate Professor Ingraham, Assistant Professor Hamilton.

103-104. Modern Spanish Literature. Four credit hours. The year. Four recitations weekly. May be taken by students who enter with two units entrance credits in Spanish. Prerequisite, Spanish 101-102, or two units entrance credits. Associate Professor Ingraham.

The Novel and Drama of the nineteenth century. Composition and Practice in speaking continued.

## SHOPWORK

(See Industrial Arts)

## SPANISH

(See Romance Languages)

# GENERAL INFORMATION

## THE STILLMAN W. ROBINSON FELLOWSHIP

The Stillman W. Robinson Fellowship in Engineering, endowed by Emeritus Professor Robinson for the encouragement of graduate research work in engineering, provides five hundred ($500.00) dollars annually, and is open to graduates in Mechanical, Civil, and Electrical Engineering. Any student to whom this fellowship is awarded must devote his entire time to the work, which shall amount to at least sixteen hours per week, of which at least eight shall be in the line of original research or investigation. For further information consult or address the Secretary of the Engineering College.

## FEES AND EXPENSES

### GENERAL CHARGES

All term dues must be paid at the opening of each semester as a condition of admission to classes.

INCIDENTAL FEE—The fee for students, residents of Ohio, is ten dollars a semester, payable in advance as a condition of registration. The fee for non-residents is fifteen dollars a semester, payable in advance as a condition of registration. In the matter of fees, children of alumni are treated as residents of Ohio.

In the case of former students, if this fee is not paid until the second day of the semester, one dollar will be added, and for each succeeding day of delinquency, fifty cents will be added.

TUITION—Tuition is free in the College of Engineering.

LABORATORY FEES—Students in all laboratory courses are required to pay a flat fee of two dollars per semester for each laboratory course making use of gas, water, electric current, or steam; the fee for all other laboratory courses is one dollar. The sums thus derived are to cover in part the loss and deterioration of the expensive instruments used by them. In addition, an effort is made in each department to assess upon the students of each laboratory course the cost of the supplies and materials consumed by them. These fees vary considerably in different departments, and they are generally collected in the form of cash advances when the student enters, the unexpended balance being returned to him at the end of the semester.

In those departments where the laboratory work is chemical, the student buys a card for five dollars at the beginning of the course, and from that card is supplied with chemicals and apparatus as he needs them, the value of each purchase being punched out of the card at the time. All first-year students in elementary chemistry are required to purchase a ten dollar card, which, with reasonable care, will cover all the expenses for supplies for the year. When the card is exhausted, another must be purchased. The store room redeems all unused cards at face value. In addition a deposit of five dollars is required as security against breakage or loss of the equipment of the desks, which is not supposed to be worn out or consumed, as in the case of chemicals.

GYMNASIUM LOCKER FEE—A fee of two dollars a semester is required from those who make use of a locker in the gymnasium. This fee includes towels.

CADET UNIFORMS—The uniform with which the members of the regiment are required to provide themselves costs (without overcoat) about twelve dollars and a half. It is quiet in pattern, and is designed to be worn in place of civilian dress.

GRADUATION FEE—A fee of five dollars, to cover expense of graduation and diploma, is required of each person receiving one of the ordinary degrees from the University, and this fee must be paid before the degree is conferred. A like fee of ten dollars is charged to each person receiving one of the higher graduate degrees.

### TOTAL AMOUNT OF FEES

The element of economy on the part of the student enters somewhat into the cost of pursuing laboratory courses. For this reason it is impossible to fix accurately the costs for a term or a year. In pursuing the courses of the College of Engineering, it is not likely that a student could get through a year's work with an expenditure in fees of less than thirty ($30.00) dollars, nor is it likely that the amount would ever exceed fifty ($50.00) dollars, except in cases of fines being assessed for gross carelessness or needless destruction of property.

### ROOMS AND BOARD

Boarding clubs are formed in the neighborhood of the University. Furnished rooms are rented at one dollar to a dollar and a half a week for each student, and the cost of table board is three to three dollars and a half a week.

Board with furnished rooms can be obtained in private families within convenient distance of the University, at rates varying from four to six dollars per week. The ruling rate may be taken as five dollars.

The other expenses incident to living at Columbus will bring the total cost per year, exclusive of clothing, up to from $250 to $400, according to the degree of economy exercised by the student.

## SELF SUPPORT

There is considerable amount of work upon the farm and in the shops and laboratories of the University which may be assigned to students on application. Preference is given to those studying Agriculture or one of the Engineering courses. *The University cannot promise work to all appli-*

*cants.* Many students find work in private families, in offices, and in various occupations, by means of which they defray at least a portion of their expenses. A person of ability and energy, who is master of a trade or who can do good work of any kind, can generally find remunerative employment. It has seldom been known that any student of ordinary energy and industry was obliged to leave the University because of a lack of money for necessary expenses, after having been sixty days on the ground—or long enough to inform himself as to the opportunities for securing employment. As an accommodation the executive office cooperates as far as possible in this matter. The Y. M. C. A. offers its services in helping young men to secure employment. Very much depends, however, on the individual's power of initiative. Students should not come to the University expecting others to find places for them. They should report to the executive office from time to time as to their needs and their work. This will enable the authorities to be more helpful than otherwise would be possible.

A student devoting much of his time to earning his way will be unable to carry successfully the full amount of collegiate work. Such students should apply for the privilege of carrying reduced work. This, of course, means that the time required to obtain a degree will be extended to five or more years, according to the amount of work successfully carried each year.

CONSULTATION—For consultation in regard to their status as members of the College of Engineering, or for the filing of petitions, changes of course, changes of class cards, adjustment of schedules and similar needs, students will apply to the Secretary, Mines Building, Room 233, from 10 to 11 a. m.

The Ohio State University Bulletin is issued at least fifteen times during the academic year; monthly in October, November, and June, and bi-weekly in December, January, February, March, April, and May.

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VOLUME XV NUMBER 15

# The Ohio State University Bulletin

## College of Engineering

March, 1911

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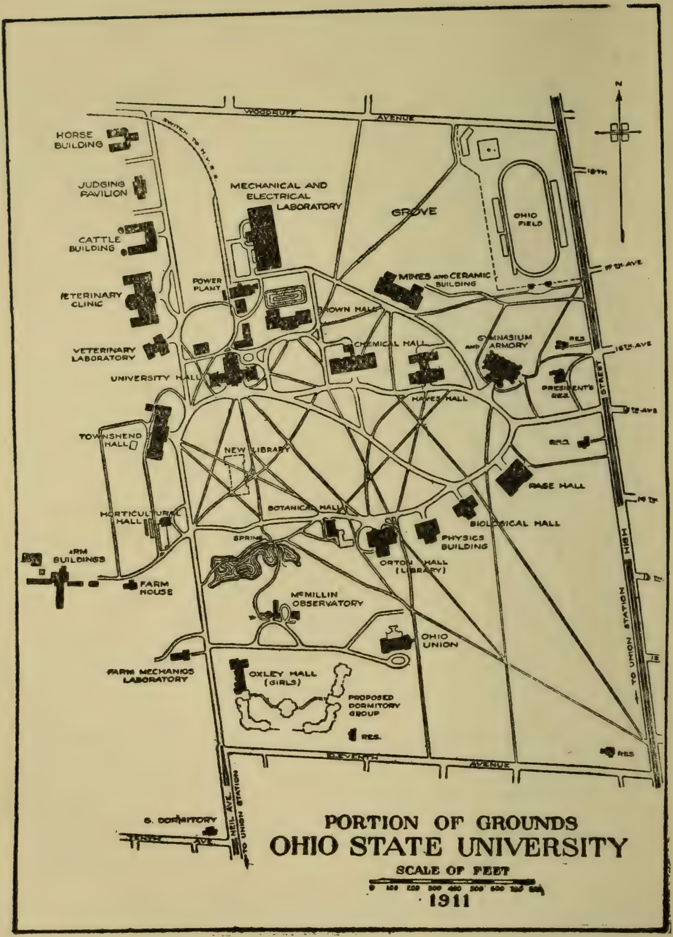

PORTION OF GROUNDS
OHIO STATE UNIVERSITY

SCALE OF FEET

1911

# THE OHIO STATE UNIVERSITY

The Ohio State University, located in Columbus two miles north of the Union Station, is a part of the public educational facilities maintained by the State. It comprises seven colleges:

The College of Agriculture,
The College of Arts, Philosophy, and Science,
The College of Education,
The College of Engineering,
The College of Law,
The College of Pharmacy,
The College of Veterinary Medicine.

This bulletin of announcements is devoted exclusively to the work of the College of Engineering, offered during the academic year beginning September, 1911.

[NOTE—The University publishes a bulletin descriptive of each College. Copies may be obtained by adressing W. E. Mann, University Editor, Columbus, Ohio, and stating the college in which the writer is interested.]

# UNIVERSITY CALENDAR

## 1911

Entrance examinations (8 a. m.), Tuesday to Saturday, June 6 to 10.

Summer Session, June 19 to August 11.

Entrance examinations (8 a. m.), Tuesday to Saturday, September 5 to 9.

First semester begins—Registration Day—Tuesday, September 12.

President's Annual Address (11 a. m.), Friday, September 15.

Latest date of admission to candidacy for a degree at the Commencement of June 1912, Monday, October 2.

Date for mid-semester reports to the Deans concerning delinquent students, Saturday, November 18.

Thanksgiving recess begins November 29 (6 p. m.), and ends December 4 (8 a. m.).

Christmas recess begins Friday, December 22 (6 p. m.).

## 1912

Christmas recess ends Tuesday, January 2 (8 a. m.).

Winter Course in Agriculture and Dairying begins Tuesday, January 2.

First semester ends Thursday, February 1 ( 6 p. m.).

Second semester begins—Registration Day—Tuesday, February 6.

Washington's Birthday, Thursday, February 22.

Date for mid-semester reports to the Deans concerning delinquent students, Saturday, March 30.

Competitive Drill—Cadet Regiment—Saturday, May 25.

Memorial Day, Thursday, May 30.

Final examinations, Friday to Thursday, May 31 to June 6.

Entrance examinations (8 a. m.), Tuesday to Saturday, June 4 to 8.

Commencement, Wednesday, June 12.

# THE COLLEGE OF ENGINEERING

The purpose of the College of Engineering is to instruct students thoroughly in the fundamental sciences and arts upon which all Engineering rests, and to impart such special and technical knowledge of the various branches of engineering as will enable students to enter them and maintain themselves while gaining their professional experience. In addition, it is believed that the severe mental discipline of the various courses of instruction makes the engineering curriculum fully the equal of any other in general educational value.

## COURSES LEADING TO BACHELOR DEGREES

This college offers instruction in seven important fields of engineering work. Covering these the following four-year courses of study are offered:

1. Architecture, leading to the degree of Bachelor of Architecture, (B. Arch.)
2. Ceramic Engineering, leading to the degree of Bachelor of Ceramic Engineering, (B. Cr. E.)
3. Chemical Engineering, leading to the degree of Bachelor of Chemical Engineering, (B. Ch. E.)
4. Civil Engineering, leading to the degree of Bachelor of Civil Engineering, (B. C. E.)
5. Electrical Engineering, leading to the degree of Bachelor of Electrical Engineering, (B. E. E.)
6. Mechanical Engineering, leading to the degree of Bachelor of Mechanical, Engineering, (B. M. E.)
7. Mine Engineering leading to the degree of Bachelor of Engineering in Mining, (B. E. M.)

The above degree will be conferred regularly for the first time in 1915. Students graduating before that time will receive degrees as published in prior issues of this bulletin, unless by special agreement between the faculty and students concerned.

## COMBINATION COURSES

It is possible to arrange combination courses leading to two degrees (see page 32) in five or more years.

## GRADUATE COURSES

Graduate courses leading to a Master's degree in one year are also offered to those holding the Bachelor's degree.

## SHORT COURSES

The following two-year, or short courses, do not lead to a degree, but students completing them are furnished a formal certificate stating the work they have accomplished:

1. Clay-working.
2. Industrial.
3. Mining.

# CORPS OF INSTRUCTION

## EXECUTIVE

William Oxley Thompson, D. D., LL. D., President of the University.

Carl E. Steeb, B. Ph., Secretary of the Board of Trustees.

Edward Orton, Jr., E. M., Dean of the College of Engineering.

Edwin F. Coddington, C. E., Ph. D., Secretary of the College of Engineering.

Edith D. Cockins, B. A., Registrar.

Olive Branch Jones, B. A., Librarian.

## ARCHITECTURE

Joseph Nelson Bradford, M. E., Professor.

Charles St. John Chubb, Jr., C. E. (Arch.), Associate Professor.

F. H. Haskett, Instructor.

## ASTRONOMY

Henry Curwen Lord, B. Sc., Professor.

Edmund S. Manson, Jr., S. M., Associate Professor.

## CERAMIC ENGINEERING

Edward Orton, Jr., E. M., Professor.

Ross C. Purdy, Cer. E., Associate Professor.

Homer F. Staley, B. Sc., Assistant Professor.

Carl B. Harrop, E. M., Instructor.

Amos P. Potts, Instructor.

## CHEMISTRY

William McPherson, D. Sc., Ph. D., Professor.

Sidney Augustus Norton, Ph. D., LL. D., Emeritus Professor.

William Edwards Henderson. Ph. D., Professor.

Charles William Foulk, B. A., Professor.

William Lloyd Evans, Ph. D., Associate Professor.

James Renwick Withrow, Ph. D., Associate Professor.

John Wilkinson, Ph. D., Instructor.

David Raymond Kellogg, M. A., Instructor.

Cecil Ernest Boord, M. A., Assistant.

George Weatherworth Stratton, M. A., Assistant.

Edgar John Witzemann, M. A., Assistant.

Ralph Edwin Hall, M. S., Assistant.

A. W. Davison, Assistant.

E. E. HOCKETT, Fellow.
T. E. FOGLESANG, Fellow.
H. B. WEISER, Fellow.
E. E. MARBARKER, Fellow.
R. C. HUMMEL, Fellow.

## CIVIL ENGINEERING

*CHRISTOPHER ELIAS SHERMAN, C. E., Professor.
FRANK HARVEY ENO, B. S., C. E., Professor.
CLYDE T. MORRIS, C. E., Professor.
H. D. BRUNING, C. E., Associate Professor.
ROY K. SCHLAFLY, C. E., Assistant Professor.
JOHN ROSS CHAMBERLIN, Assistant Professor.
ALBERT HARRISON HINKLE, C. E., Instructor.
HARRY WALTER STERTZBACH, C. E., Instructor.

## ELECTRICAL ENGINEERING

FRANCIS CARY CALDWELL, B. A., M. E., in E. E. Professor.
JOHN HERMAN HUNT, B. S. in E. E., Associate Professor.
LOREN WALLACE MCOMBER, B. S., Assistant Professor.
JOHN ERNEST SHEPARDSON, B. S., Assistant.
ALBERT HENRY HEITMANN, M. E. in E. E., Assistant.

## ENGINEERING DRAWING

THOMAS EWING FRENCH, M. E., Professor.
ROBERT MEIKLEJOHN, M. E., Assistant Professor.
OWEN ETSEL WILLIAMS, Instructor.
ARTHUR C. HARPER, M. E., Instructor.
WILLIAM JAMES NORRIS, Instructor.
CREE SHEETS, C. E., (Arch.), Instructor.
FREDERICK W. IVES, B. S. in M. E., Instructor.
WILLIAM D. TURNBULL, C. E., Instructor.

## ENGLISH

JOSEPH VILLIERS DENNY, M. A., Professor.
GEORGE H. MCKNIGHT, Ph. D., Professor.
WILLIAM LUCIUS GRAVES, M. A., Associate Professor.
CARSON SAMUEL DUNCAN, M. A., Assistant Professor.
LOUIS ALBION COOPER, B. A., Assistant Professor.
HARRY F. HARRINGTON, M. A., Assistant Professor.
EDWIN L. BECK, M. A., Assistant Professor.

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*Absent on leave 1911-1912.

## GEOLOGY

CHARLES SMITH PROSSER, D. Sc., Ph. D., Professor.
JOHN ADAMS BOWNOCKER, D. Sc., Professor.
THOMAS M. HILLS, B. Ph., Assistant Professor.
WILLIAM CLIFFORD MORSE, M. A., Instructor

## GERMANIC LANGUAGES AND LITERATURES

BERTHOLD AUGUST EISENLOHR, M. A., Associate Professor.
MAY THOMAS, Ph. D., Assistant Professor.
SARAH TRACY BARROWS, M. L., Assistant Professor.
ROBERT OSCAR BUSEY, M. A., Instructor.

## INDUSTRIAL ARTS

FRANK EDWIN SANBORN, S. B., Professor.
WILLIAM ABNER KNIGHT, M. E., Associate Professor.
CHARLES PHILIP CROWE, Instructor.
CLEMENT MEDARY BEEM, Instructor.
ALLANDO A. CASE, Instructor.
ULYSSES WALLACE DENMAN, Assistant.
..........................., Assistant.

## MATHEMATICS

ROSSER DANIEL BOHANNAN, B. Sc., C. E. E. M., Professor.
GEORGE WASHINGTON MCCOARD, M. A., Professor.
KARL DALE SWARTZEL, M. Sc., Professor.
*HARRY WALDO KUHN, Ph. D., Professor.
CHARLES LINCOLN ARNOLD, M. Sc. Associate Professor.
SAMUEL EUGENE RASOR, S. M., Associate Professor.
JOHN BOWKER PRESTON, M. A., Assistant Professor.
GRACE MARIE BAREIS, B. A., Assistant Professor.
CHARLES CLEMENT MORRIS, M. A., Assistant Professor.
CARL JOSEPH WEST, M. A., Assistant Professor.
JAMES H. WEAVER, A. B., Instructor.
HORTENSE RICKARD, B. A., Assistant.

## MECHANICAL ENGINEERING

*WILLIAM THOMAS MAGRUDER, M. E., Professor.
EMBURY ASBURY HITCHCOCK, M. E., Professor.
HORACE JUDD, M. E., M. Sc., Associate Professor.
ALEXANDER VALLANCE, M. E., Assistant Professor.
CORY C. MCCLELLAND, M. E., Assistant.
............................., Assistant.

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*Absent on Leave, 1911-1912

## MECHANICS

JAMES ELLSWORTH BOYD, M. S., Professor.
EDWIN F. CODDINGTON, C. E., Ph. D., Associate Professor.

## METALLURGY AND MINERALOGY

†NATHANIEL WRIGHT LORD, E. M., Professor.
EDWARD ELSWORTH SOMERMEIER, G. Ph., Professor.
DANA JAMES DEMOREST, B. Sc. (Chem.), Assistant Professor.

## MILITARY SCIENCE AND TACTICS

GEORGE L. CONVERSE, U. S. A., (Ret.), Professor.

## MINE ENGINEERING

FRANK ARNOLD RAY, E. M., Professor.
WELLS H. MINOR, E. M., Assistant Professor.
IRA CALLENDER, Student Assistant.
C. M. SHINN, Student Assistant.

## PHYSICAL EDUCATION

H. SHINDLE WINGERT, M. D., Professor.

## PHYSICS

ALFRED DODGE COLE, A. M., Professor.
BENJAMIN FRANKLIN THOMAS, Ph. D., Professor.
ROBERT FRANCIS EARHART, Ph. D., Associate Professor.
F. C. BLAKE, Ph. D., Assistant Professor.
*CHARLES SHEARD, A. M., Assistant Professor.
ALPHEUS WILSON SMITH, Ph. D., Assistant Professor.
HERMAN GUSTAVUS HEIL, Ph. B., Instructor.
GEORGE O. WEIMER, M. E. in E. E., Assistant.
FRANK W. POTE, B. S. in E. E., Assistant.
R. L. EDWARDS, Fellow.
..............., Fellow.

## ROMANCE LANGUAGES AND LITERATURES

BENJAMIN LESTER BOWEN, Ph. D., Professor.
CHARLES A. BRUCE, B. A., Professor,
EDGAR SHUGERT INGRAHAM, Ph. D., Associate Professor.
THEODORE ELY HAMILTON, Ph. D. Assistant Professor.
.........................., Assistant Professor.
GEORGE S. CHAPIN, B. A., Instructor.

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NOTE: Names left blank indicate that positions were not filled when the bulletin went to press.

†Died, May 23, 1911.

*Absent on leave, 1911-1912.

# ADMISSION

Applicants for admission must be at least seventeen years of age. The College is open on equal terms to both sexes.

## UNIVERSITY ENTRANCE BOARD

The admission of students is in charge of the University Entrance Board, which determines the credit which shall be issued on all entrance examinations and certificates, and furnishes all desired information to applicants. Correspondence relating to admission should be addressed to the Entrance Board, Ohio State University, Columbus.

## ADMISSION TO COURSES LEADING TO DEGREES

There are two modes of admission to courses leading to degrees: (a) by examination, (b) by certificate.

## ADMISSION BY EXAMINATION

The Entrance Board will conduct entrance examinations June 6 to 10, and September 5 to 9, 1911. Part of the examinations may be taken in June and the remainder in September. All applicants for admission who do not possess certificates covering entrance requirements must take examinations for admission.

SCHEDULE OF EXAMINATIONS. The hours for examinations are 8 A. M. and 1 P. M. Students intending to take any of the examinations scheduled in any given half day must appear within one hour of the time set for the examination. Students applying for examination will first go to the office of the Entrance Board, 100 University Hall, for registration.

| | | |
|---|---|---|
| Tuesday | A. M. | History: Ancient and Mediæval (to 814), Mediæval and Modern (after 814), English. |
| “ | P. M. | English Composition and Rhetoric, English Classics, Chemistry. |
| Wednesday | A. M. | Algebra, Physical Geography. |
| “ | P. M. | Plane Geometry, German, Spanish. |
| Thursday | A. M. | Civil Government, Solid Geometry, Zoölogy. |
| “ | P. M. | Beginning Latin and Cæsar, Elements of Agriculture, Trigonometry. |
| Friday | A. M. | Physics, Physiology, Botany. |
| “ | P. M. | American History, French, English Literature. |
| Saturday | A. M. | Vergil, Cicero, Domestic Science. |

A special bulletin of entrance information will be mailed on request. Address The University Editor.

## ADMISSION BY CERTIFICATE

Applicants may be admitted without examination on presentation of properly endorsed certificates from such secondary schools as have been accredited or recognized by the University, or from approved normal schools, or from the State Board of School Examiners under the following provisions.

(a) If from secondary schools, the certificate must show that the applicant is a graduate in good standing of the school issuing it; and also must state in detail the studies pursued, the text-books used, the amount of work done in each study, the amount of time devoted to it, and the fact that the applicant has passed in the work.

(b) Any entrance requirement not covered by a certificate must be met by examination.

Blank certificates may be obtained by addressing the Secretary of the Entrance Board. Certificates should be filled out and returned by the proper official to the University as early as possible after the close of schools in June.

## REQUIREMENTS BY UNITS

To obtain full standing in the College of Engineering, applicants under twenty-one years of age must have credit by examination or certificate for fifteen units. A unit is the equivalent of a course of study covering a school year, during which one hundred and twenty clock-hours are devoted to class-room work on the study. Two hours in the laboratory are equivalent to one hour in the class-room.

Of these fifteen units, not less than three shall be English, one history, three mathematics (including solid geometry), one physics, four languages (other than English), and the balance shall be elective, all to be taken from the following list. Preparation in excess of the minimum requirement in any subject must amount to at least one-half unit to be counted.

| | |
|---|---|
| English | 4 units |
| (Foreign students may substitute their native language for the English requirment.) | |
| American History or American History and Civil Government | 1 unit |
| Ancient History (Greek and Roman) and Mediæval History to 814 A. D. | 1 unit |
| Mediæval and Modern History (from 814 A. D. to the present) | 1 unit |
| (For the present General History may be counted as a unit, but not in addition to Ancient or Mediæval and Modern History.) | |
| English History | 1 unit |
| Algebra (through quadratics) | 1 unit |
| Algebra (beyond quadratics) | ½ unit |
| Geometry (plane) | 1 unit |
| Geometry (solid) | ½ unit |
| Trigonometry | ½ unit |
| Latin | 2, 3, or 4 units |
| Greek | 2, 3, or 4 units |
| German | 2, 3, or 4 units |
| French | 2, 3, or 4 units |
| Spanish | 2, 3, or 4 units |
| (Not less than two units of any language will be accepted.) | |

| | | |
|---|---|---|
| Physics | | 1 unit |
| Chemistry | | 1 unit |
| Physical Geography | | 1 unit |
| Zoölogy | | 1 unit |
| Botany | | 1 unit |
| Physical Geography<br>Zoölogy<br>Botany<br>Physiology | For the present any two of these may be counted together as | 1 unit |
| Agriculture<br>Free-hand drawing<br>Manual Training*<br>Domestic Science | The Entrance Board may, after investigating each claim, grant a total credit of not to exceed | 2 units |

No student under twenty-one years of age will be admitted to college if he is conditioned in more than two of the fifteen units. An applicant twenty-one years of age or over may be admitted with a total deficiency of four units, provided at least two of the four are in the foreign language group.

Students over twenty-one years of age, may also be admitted as special students in accordance with the provisions stated under "Admission to Special Studies."

The extent and character of the work required in each subject mentioned above is explained in a special bulletin which will be sent by the University Editor to any address, upon request.

## ADMISSION WITH ADVANCED STANDING

Applicants who have completed at least one year's work in an approved college, and who bring official and explicit certificates describing their course of study and scholarship, and letters of honorable dismissal, will be admitted in accordance with either of two plans:

(1) The entrance units on which the candidate was admitted to the approved college will be accepted at their

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*Students expecting to enter the College of Engineering are advised to take free-hand drawing in the high school.

face value; deficiencies will be made up from the college credits presented, and advanced credit will be given for any remaining satisfactory work; or

(2) One year's work will be accepted in lieu of entrance units and the candidate will be admitted without examination and without conditions, but without any advanced standing on the year's work.

Applicants who have completed less than one year's work in an approved college must satisfy the entrance requirements in the usual way, and will then be given credit for any satisfactory work for which they can offer certificates.

## ADMISSION TO SPECIAL STUDIES

Students who desire to pursue special lines of work in the University, and do not intend to become candidates for degrees, will be admitted on the following conditions:

1. If the applicant can satisfy the entrance requirements, he should send to the Entrance Board for reference to the Executive Committee of the Engineering College a complete statement of the course which he wishes to take, together with his reasons for desiring this course, and a detailed statement of his practical experience in Engineering.

2. If he can not satisfy the entrance requirements, but is at least twenty-one years of age, he *may* be admitted by the joint action of the Entrance Board and the Executive Committee of the Engineering College, provided he passes the entrance examinations in Algebra and Plane Geometry. Such a student must send a full statement of the course he wishes to pursue, his practical experience in Engineering, and certificates from his employers giving the nature and duration of his experience.

3. Permission to enter as special undergraduates will be refused to all who fail to give satisfactory evidence of

definiteness of purpose and will be withdrawn whenever the conditions on which it was granted cease to exist.

## ADMISSION TO THE SHORT COURSES

Applicants must be at least seventeen years of age and, unless they are over twenty-one years of age, must pass examinations in Arithmetic and Geography, and must be able to write a business letter or a short theme, correct in grammar and orthography; or they must present satisfactory certificates showing that they have successfully pursued these subjects elsewhere. In addition, each applicant under twenty-one years of age must present a letter or certificate showing that he has had at least two year's consecutive practical experience in some industry related to the course which he wishes to pursue, and this certificate must be satisfactory to the Executive Committee of the College of Engineering.

Applicants over twenty-one years of age are admitted without examination, but must present a letter or certificate covering practical experience, as provided in the case of those less than twenty-one years of age.

## REMOVAL OF ENTRANCE CONDITIONS

The removal of entrance conditions is administered by the Entrance Board. Conditions may be removed (1) by examination or (2) by the substitution of excess work in other approved subjects, or (3) by the substitution of other equivalent work to be done at the University. All entrance conditions must be removed within two years after admission. If, at the end of the first year, a student still has entrance conditions outstanding, the Secretary of the College will assign such college courses as may be deemed a fair equivalent for the work in which the student has entrance conditions. A condition in physics must be removed before entering on the work of the second year.

# COURSES OF STUDY

## OUTLINE OF THE FIRST YEAR'S WORK OF ALL FOUR-YEAR COURSES

In order to permit all engineering students to have a year in which to ascertain their tastes more fully and find out definitely what course they desire to pursue, the first year of all engineering courses is made uniform. While students are asked to indicate their choice of courses on entering the college, they can change at the end of the first year without any inconvenience.

Note—The figure in parenthesis following the name of each study indicates the number of the study in its department; the other figure indicates the number of credit hours.

| First Semester | | Second Semester | |
|---|---|---|---|
| Mathematics (131)<br>College Algebra and Trig. | 5. | Mathematics (132)<br>Trig. and Analytics. | 5. |
| Chemistry (105 or 109)<br>General Chemistry. | 4. | Chemistry (106 or 110)<br>General Chemistry and Qualitative Analysis. | 4. |
| Modern Language<br>French, Ger., or Span. | 4. | Modern Language<br>French, Ger., or Span. | 4. |
| English (101)<br>Paragraph Writing. | 2. | English (104)<br>Paragraph Writing. | 2. |
| Engineering Drawing (101)<br>Elementary Mechanical. | 2. | Engineering Drawing (102)<br>Lettering and Projections. | 3. |
| Military Drill | 1. | Military Drill | 1. |
| Gymnasium | 1. | Gymnasium | 1. |

Students presenting Chemistry as an entrance subject will take Chemistry 109 and 110. Students with no entrance credits in Chemistry will take Chemistry 105 and 106.

Summer Session—Students electing courses named below are required to take courses in the Summer Session as follows:

Ceramic Engineering—Two from Shopwork (107), (109) and (115), at the close of the first year.

Chemical Engineering—Shopwork (109) and (115) at the close of the first or second year.

Electrical Engineering, Mechanical Engineering and Mine Engineering—Shopwork (109) and (115) at the close of the first year.

## ARCHITECTURE

The special architectural work of the course commences in the second year with history of architecture which affords instruction in the principles governing design in classic, mediæval and renaissance work, and the proper use to be made of precedent. The history of architecture is accompanied by a course in drawing and design devoted to the ''orders'' and ''order problems.'' Courses involving class and drawing room work are given during this year in shades and shadows, and architectural perspective.

Throughout the third and fourth years practical designing courses are given, which include problems relating to residences, apartment houses, school buildings, public buildings, tall steel constructed office buildings, and ecclesiastical structures. Decoration, architectural composition, working drawings, and structural details are covered in separate courses during the third year, while monumental design, specifications, estimating, sanitary plumbing, and professional practice are studied in the fourth year.

Drawing, both freehand and mechanical, is very essential to the architect. Thus, in addition to the extensive practice which the student gets in his designing, a series of courses in drawing and allied subjects runs through the four years.

On the structural side courses are given in trusses, cement work, masonry, steel construction, reinforced concrete, and surveying. Work in the testing of materials and in heating and ventilating is also given. A thesis, usually the complete plans and specifications for some important structure, is required before graduation.

## COURSE IN ARCHITECTURE

FOR FIRST YEAR SEE PAGE 17.

### SECOND YEAR

| First Semester | | | Second Semester | | |
|---|---|---|---|---|---|
| Mathematics<br>Calculus. | (141) | 5. | Mathematics<br>Calculus. | (142) | 5. |
| Engineering Drawing<br>Charcoal from Ornament. | (115) | 2. | Engineering Drawing<br>Pen Drawing. | (116) | 2. |
| Architecture<br>History of Architecture. | (101) | 3. | Architecture<br>History of Architecture. | (102) | 3. |
| Architecture<br>Order Problems. | (103) | 2. | Architecture<br>Order Problems. | (104) | 5. |
| Engineering Drawing<br>Descriptive Geometry. | (107) | 3. | Architecture<br>Shades, Shadows and Persp. | (124) | 3. |
| Physics<br>General Physics. | (111) | 3. | | | |
| Military Drill | | 1. | Military Drill | | 1. |

Summer Course—Architecture (120), Architectural Practice, or an Architectural Problem.

### THIRD YEAR

| | | | | | |
|---|---|---|---|---|---|
| Mechanics<br>Statics and Str. of Mater'ls. | (101) | 5. | Mechanics<br>Strength of Materials. | (104) | 2. |
| Engineering Drawing<br>Water Color. | (117) | 3. | Engineering Drawing<br>Charcoal from Antique. | (118) | 3. |
| Architecture<br>Design. | (107) | 5. | Architecture<br>Design. | (108) | 4. |
| Architecture<br>Decoration, etc. | (109) | 3. | Architecture<br>Working Drawings. | (110) | 4. |
| Architecture<br>Arch. Composition. | (113) | 2. | Architecture<br>Photography. | (112) | 2. |
| | | | Civil Engineering<br>Trusses. | (124) | 3. |

Summer Course—Architecture (121), Architectural Practice, or an Architectural Problem.

### FOURTH YEAR

| | | | | | |
|---|---|---|---|---|---|
| Architecture<br>Design. | (115) | 6. | Architecture<br>Design. | (114) | 3. |
| Architecture<br>Plumbing. | (117) | 1. | Architecture<br>Professional Practice. | (116) | 4. |
| Architecture<br>Masonry. | (119) | 2. | Civil Engineering<br>Surveying. | (128) | 2. |
| Civil Engineering<br>Tall Buildings. | (125) | 3. | Civil Engineering<br>Cement and Concrete. | (118) | 3. |
| Mechanical Eng.<br>Materials of Const. | (123) | 2. | Architecture<br>Thesis. | (118) | 5. |
| Mechanical Eng.<br>Heating and Ventilating. | (121) | 2. | | | |
| Engineering Drawing<br>Clay Modeling. | (119) | 2. | | | |

## CERAMIC ENGINEERING

Ceramic Engineering is the application of Chemistry and Engineering to a well defined group of non-metallic mineral industries, viz., clayworking, glass manufacture and cement manufacture. These industries all manufacture silicate products and employ the same raw materials to a large extent, and thus constitute a natural division of chemical technology.

The ceramic engineer should be something of a geologist and mining engineer in order to discover and work his raw materials. He should be a mechanical engineer to prepare these materials and manufacture them into the required shape, and he must be a chemist to understand what takes place in kilns and furnaces. His course, while founded upon chemical technology, must still be broad and varied, and include a liberal amount of general engineering.

The technical work in ceramic engineering begins in the second year with a laboratory course running through the year, dealing with the chemical analysis of the various materials used in the ceramic industries. During the last semester this is accompanied by a course in ceramic calculations. In the third year this work is continued by a course of lectures through the year, which cover the winning of the raw materials, their preparation and manufacture, and the drying, burning, and the decoration of the ceramic products. In the fourth year, laboratory courses on the manufacture of ceramic bodies, the production of glazes, and the production of enamels and colors continue the ceramic training. However a course on cement manufacture may be elected in place of the course on enamels and colors. In this year there is also a course on the drawing and design of ceramic structures. The ceramic subjects constitute about 35 percent of the total work required for the degree.

## COURSE IN CERAMIC ENGINEERING

FOR FIRST YEAR SEE PAGE 17

### SECOND YEAR

| FIRST SEMESTER | | | SECOND SEMESTER | | |
|---|---|---|---|---|---|
| Mathematics<br>Calculus. | (141) | 5. | Mathematics<br>Calculus. | (142) | 5. |
| Physics<br>Mechanics and Heat. | (113) | 5. | Physics<br>Elec., Light and Sound. | (114) | 5. |
| Engineering Drawing<br>Descriptive Geometry. | (103) | 3. | Engineering Drawing<br>Machine Sketching. | (104) | 3. |
| Ceramic Engineering<br>Ceramic Chemistry. | (101) | 5. | Ceramic Engineering<br>Laboratory. | (102) | 3. |
| | | | Ceramic Engineering<br>Ceramic Calculations. | (106) | 2. |
| Military Drill | | 1. | Military Drill | | |

### THIRD YEAR

| | | | | | |
|---|---|---|---|---|---|
| Mechanics<br>Statics and Str. of Materials. | (101) | 5. | Mechanics<br>Strength of Materials. | (104) | 2. |
| Chemistry<br>Physical Chemistry. | (157) | 3. | Chemistry<br>Physical Chemistry. | (158) | 3. |
| Mine Engineering<br>Mine Surveying. | (103) | 5. | Mechanical Eng.<br>Mechanism and Design. | (110) | 3. |
| Ceramic Engineering<br>Ceramic Manufacture. | (103) | 5. | Ceramic Engineering<br>Ceramic Manufacture. | (104) | 5. |
| | | | Ceramic Engineering<br>Phys. Chem. Measurements. | (108) | 3. |
| | | | Ceramic Engineering<br>Glazes and Colors. | (110) | 2. |

### FOURTH YEAR

| | | | | | |
|---|---|---|---|---|---|
| Ceramic Engineering<br>Laboratory. | (111) | 5. | *Ceramic Engineering<br>Laboratory. | (112) | 5. |
| Ceramic Engineering<br>Drawing. | (113) | 2. | Ceramic Engineering<br>Drawing. | (114) | 3. |
| Mechanical Eng.<br>Laboratory and Lecture. | (171) | 4. | *Ceramic Engineering<br>Cement Lectures. | (118) | 5. |
| Civil Engineering<br>Trusses. | (123) | 3. | Civil Engineering<br>Cement and Concrete. | (118) | 3. |
| Metallurgy.<br>Gen. Metallurgy. | (109) | 4. | Geology<br>General Geology. | (168) | 3. |
| | | | Ceramic Engineering<br>Thesis. | (116) | 4. |

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*Alternative Courses. One must be taken.

## CHEMICAL ENGINEERING

The course in Chemical Engineering has been prepared to meet the growing demands for trained men in the numerous industries which employ chemical processes prominently in their work, and which are not included in the fields of metallurgy and ceramics. Among such may be mentioned the manufacture of acids, alkalies, salts, paints, dyes, soaps, glue, starch, sugar, preservatives, antiseptics, fertilizers, and others.

This course differs from the ordinary course in chemistry in that it is extended greatly along engineering lines. There are four full years' work in consecutive chemical courses: elementary chemistry and qualitative analysis in the first year; advanced chemistry and quantitative analysis in the second, organic chemistry in the third, and physical and industrial chemistry in the fourth. In addition there are several smaller elective courses in chemistry, which the student may elect, and further chemical applications are given in another department in metallurgy, assaying and mineralogy.

In the engineering line, beside the usual fundamental work in mathematics, physics, mechanics and drawing, four weeks each of carpentry and forging is given in the first summer, a course in technical drawing, dealing chiefly with chemical machinery in the third year. This leads up to a course in machine design in the fourth year. There are also courses in power plants, and electrical machinery.

In addition to the elective work offered in the fourth year, three hours must be devoted to the preparation of a thesis.

## COURSE IN CHEMICAL ENGINEERING

FOR FIRST YEAR SEE PAGE 17

### SECOND YEAR

| First Semester | | | Second Semester | | |
|---|---|---|---|---|---|
| Mathematics<br>Calculcus. | (141) | 5. | Mathematics<br>Calculcus. | (142) | 5. |
| Physics<br>Gen. Physics. | (111) | 3. | Physics<br>Gen. Physics. | (112) | 3. |
| Engineering Drawing<br>Descriptive Geometry. | (103) | 3. | Engineering Drawing<br>Machine Sketching. | (104) | 3. |
| Chemistry<br>Quantitative Analysis. | (119) | 4. | Chemistry<br>Quantitative Analysis. | (120) | 4. |
| Chemistry<br>Adv. Gen. Chemistry. | (113) | 2. | Chemistry<br>Adv. Gen. Chemistry. | (114) | 2. |
| | | | Chemistry<br>Chemical Problems. | (124) | 1. |
| Military Drill | | 1. | Military Drill | | 1. |

### THIRD YEAR

| First Semester | | | Second Semester | | |
|---|---|---|---|---|---|
| Mechanics<br>Statics and Str. Mater'ls. | (101) | 5. | Mechanics<br>Kinetics and Hydraulics. | (102) | 5. |
| Engineering Drawing<br>Technical Drawing. | (121) | 2. | Engineering Drawing<br>Technical Drawing. | (122) | 2. |
| Metallurgy<br>Gen. Metallurgy. | (109) | 4. | Metallurgy<br>Mineralogy and Cryst'g'phy. | (104) | 2. |
| Chemistry<br>Organic Chem., lec. | (151) | 2. | Chemistry<br>Organic Chem., lec. | (152) | 2. |
| Chemistry<br>Organic Chem., lab. | (153) | 2. | Electives<br>(See foot note.) | | 6 to 8 |
| Mechanical Eng.<br>Steam Power Plants. | (103) | 3. | | | |

### FOURTH YEAR

| First Semester | | | Second Semester | | |
|---|---|---|---|---|---|
| Mechanical Eng.<br>Machine Design. | (127) | 5. | Mechanical Eng.<br>Machine Design. | (144) | 5. |
| Chemistry<br>Physical Chemistry. | (157) | 3. | Chemistry<br>Physical Chemistry. | (158) | 3. |
| Chemistry<br>Industrial Chemistry. | (177) | 2. | Chemistry<br>Industrial Chemistry. | (178) | 1. |
| Chemistry<br>Indust. Chem. Lab. | (185) | 2. | Chemistry<br>Indust. Chem. Lab. | (186) | 3. |
| Electrical Eng.<br>Elementary Elec. Eng. | (101) | 5. | Chemistry<br>Thesis. | (140) | 4. |
| | | | Elective<br>Chemistry | (182 or 184) | 2. |

Electives in third year, second semester, must be chosen from the following courses, subject to approval of the departments concerned: Chemistry (136) 2, Chemical Literature; Chemistry (154) 2 or 3, Advanced Organic Chemistry; Chemistry (168) 3 to 5, Advanced Qualitative Analysis; Chemistry (176) 3, Sanitary Analysis; Chemistry (188) 2 or 3, Inorganic Preparations; Metallurgy (110) 4, General Metallurgy; Metallurgy (112) 2, Calorimetry and Mine Gas Analysis.

## CIVIL ENGINEERING

Among the special fields which are usually included under the title of civil engineering, are those of the design, construction, and maintenance of bridges, railroads, municipal water supply, sewers, street paving, road building and other public works, irrigation projects, and river and harbor improvements. The civil engineer also superintends topographic and geodetic surveys and does other special lines of work.

The course of instruction is designed to provide the foundation upon which all of these specialties are built.

The technical work begins in the second year with courses in land and railroad surveying, accompanied by practice in the field, and by class room work in topographic drawing. In the third year are courses in topographic surveying, a drawing room in timber construction and in stereotomy, a lecture and laboratory course in cement testing, and class room courses in roads and streets, bridge stresses, and sanitary engineering. In the fourth year are given courses in bridge design, masonry structures, and reinforced concrete; also class room courses in masonry construction, water supply engineering, and contracts and specifications. There is also an opportunity to select between a course in advanced bridge designing and one in railway location.

Distributed through the third and fourth years are courses in the applications of electrical machinery, least squares, astronomy, photography, water pumps and motors, testing of materials of construction, calibrations of weirs, and general geology. Most of these courses include laboratory practice. In each of the summers following the second and third years, four weeks of field practice in surveying is required, and before graduation, a thesis giving results of some original work along civil engineering lines.

## COURSE IN CIVIL ENGINEERING

FOR FIRST YEAR SEE PAGE 17

### SECOND YEAR

| First Semester | | | Second Semester | | |
|---|---|---|---|---|---|
| Mathematics<br>Calculus. | (141) | 5. | Mathematics<br>Calculus. | (142) | 5. |
| Physics<br>Gen. Physics. | (111) | 3. | Physics<br>Gen. Physics. | (112) | 3. |
| Engineering Drawing<br>Descriptive Geometry. | (105) | 3. | Engineering Drawing<br>Advanced Descriptive Geom. | (106) | 3. |
| Civil Engineering<br>Land Surveying. | (101) | 4. | Civil Engineering<br>R. R. Survey and Field Prac. | (102) | 4. |
| Civil Engineering<br>Field Prac. & Top. Drawing. | (103) | 3. | Geology<br>Gen. Geology. | (168) | 3. |
| Military Drill | | 1. | Military Drill | | 1. |

Summer Courses—Civil Engineering (104 and 111), each four weeks of six days per week. Field work in Surveying. Required in second and third years respectively.

### THIRD YEAR

| | | | | | |
|---|---|---|---|---|---|
| Mechanics<br>Statics and Str. of Mater'ls. | (101) | 5. | Mechanics<br>Kinetics and Hydraulics. | (102) | 5. |
| Civil Engineering<br>Topographic Surveying. | (105) | 3. | Civil Engineering<br>Timber Construction. | (108) | 3. |
| Civil Engineering<br>Stereotomy. | (107) | 3. | Civil Engineering<br>Roads and Streets. | (106) | 3. |
| Civil Engineering<br>Sanitary Eng. | (109) | 2. | Civil Engineering<br>Stresses in Structures. | (110) | 4. |
| Electrical Eng.<br>Elementary Elect. | (103) | 3. | Astronomy<br>Geodesy and Least Squares. | (104) | 3. |
| Architecture<br>Photography. | (111) | 2. | | | |

### FOURTH YEAR

| | | | | | |
|---|---|---|---|---|---|
| Civil Engineering<br>Bridge Design. | (113) | 4. | *Civil Engineering<br>Adv. Bridges. | (114) | 4. |
| Civil Engineering<br>Water Supply. | (117) | 3. | *Civil Engineering<br>Railways. | (112) | 4. |
| Civil Engineering<br>Masonry Construction. | (115) | 3. | Civil Engineering<br>Masonry Structures. | (116) | 3. |
| Astronomy<br>Geodesy and Least Squares. | (105) | 3. | Civil Engineering<br>Cement and Concrete. | (118) | 3. |
| Mechanical Eng.<br>Laboratory. | (173) | 5. | Civil Engineering<br>Contracts and Spec. | (120) | 2. |
| Civil Engineering<br>Thesis. | (119) | 1. | Mechanical Eng.<br>Mechanism and Mach. Des. | (140) | 2. |
| | | | Civil Engineering<br>Thesis. | (122) | 4. |

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*Alternative Course. One must be taken.

## ELECTRICAL ENGINEERING

While there are few industries into which the application of electricity does not enter, there are several, such as electric railways, lighting and power, telephony and telegraphy, railroad signaling, shop drive, etc., and the manufacture of the corresponding forms of apparatus, which call especially for an electro-technical training.

Electricity and magnetism naturally constitute the most important studies of this course. This work begins in the second year in the physics department; in the third year it occupies nearly half of the time, and includes electrical measurements, direct current dynamo machinery, and a general course covering the applications of electricity in the first semester, and an introduction to alternating current apparatus in the second. In all of this work the laboratory plays an important part in the fourth year the study of alternating current apparatus in class room and dynamo laboratory runs throughout the year. The design of dynamo machines runs through this year. Short courses are also given in electrical applications, transmission, railways, telephones, illumination, and wireless telegraphy.

Besides the work of first and second years, practice in drawing is obtained in the design work of the third and fourth years. Work in carpentry, forging, and the machine shop occupies four weeks of continuous time in the first summer and continues during the second year. The successful electrical engineer must be a good mechanical engineer. Thus, courses in mechanism, mechanical laboratory, power plants, engines and boilers, and machine design are distributed over the last two years. There are also some electives in the fourth year.

An important feature is the two inspection trips which are required in the junior and senior years.

## COURSE IN ELECTRICAL ENGINEERING

FOR FIRST YEAR SEE PAGE 17

### SECOND YEAR

| First Semester | | | Second Semester | | |
|---|---|---|---|---|---|
| Mathematics<br>Calculus. | (141) | 5. | Mathematics<br>Calculus. | (142) | 5. |
| Physics<br>Mechanics and Heat. | (113) | 5. | Physics<br>Elec., Light and Sound. | (114) | 5. |
| Engineering Drawing<br>Descriptive Geometry. | (103) | 3. | Physics<br>Laboratory. | (134) | 3. |
| Physics<br>Laboratory. | (133) | 2. | Engineering Drawing<br>Machine Sketching. | (110) | 2. |
| Shopwork<br>Machine Work. | (119) | 3. | Shopwork<br>Adv. Machine Work. | (122) | 3. |
| Military Drill | | | Military Drill | | 1. |

### THIRD YEAR

| | | | | | |
|---|---|---|---|---|---|
| Mechanics<br>Statics and Str. of Materials. | (101) | 5. | Mechanics<br>Kinetics and Hydraulics. | (102) | 5. |
| Physics<br>Laboratory. | (135) | 5. | Electrical Eng.<br>D. C. Machinery. | (104) | 5. |
| Mechanical Eng.<br>Steam Power Plants. | (103) | 3. | Mechanical Eng.<br>Steam Engines and Boilers. | (118) | 4. |
| Mechanical Eng.<br>Mechanism. | (101) | 3. | Mechanical Eng.<br>Laboratory. | (160) | 2. |
| Engineering Drawing<br>Technical. | (111) | 2. | Electrical Eng.<br>Application A. C. Prin. | (106 & 108) | 5. |
| | | | Electrical Engineering (130) or (134) Inspection Trip. | | |

### FOURTH YEAR

| | | | | | |
|---|---|---|---|---|---|
| Mechanical Eng.<br>Laboratory. | (175) | 3. | Electrical Eng.<br>A. C. Laboratory. | (112) | 3. |
| Electrical Eng.<br>A. C. Laboratory. | (111) | 3. | Electrical Eng.<br>Transmission. | (124) | 2. |
| Electrical Eng.<br>A. C. Machinery. | (109) | 3. | Industrial Arts<br>Machine Design. | (112) | 2. |
| Electrical Eng.<br>Elec. Machine Design. | (121) | 3. | Electrical Eng.<br>Inspection Trip. | (130 or 134) | |
| Electrical Eng.<br>Thesis. | (127) | 1. | Electrical Eng.<br>Thesis. | (128) | 5. |
| Electrical Engineering. | (*) | 2. | | | |
| Elective | | 2 to 4. | Elective | | 3 to 6. |

*One of the following: (113) Railways, (115) Telephones, (117) Illumination, (119) Wireless Telegraphy.

Students who, for financial or other satisfactory reasons, are unable to take Electrical Engineering 130 may substitute Electrical Engineering 134 upon receiving permission from the head of the department.

## MECHANICAL ENGINEERING

Mechanical engineering in its broadest meaning includes the invention, development, design, manufacture, and operation of all forms of machinery.

Apart from drawing and shopwork, the technical work in mechanical engineering begins in the first semester of the third year, with a descriptive course on power plants and followed by a more advanced course in steam engineering, accompanied by laboratory work and recitations and drawing practice in the principles of mechanism and mechanical movements. In the fourth year the steam engineering work is continued, with courses on gas engines and thermodynamics. A laboratory course runs throughout the fourth year, and covers the testing of materials of construction, steam, hot-air, and gas engines, power transmission, boilers, and injectors, air compressors, pumps and other hydraulic apparatus. The course in machine design runs through the year with lectures, recitations, and drawing-room practice in the applications. Courses on hydraulic machinery, and upon shop appliances and steam turbines, complete the list of mechanical engineering subjects.

Allied courses are given in the chemistry of fuels, the metallurgy of iron and steel, in timber and masonry constructions, the design of trusses, in differential equations, machinery and photography.

The two inspection trips, which are required in the junior and senior years, are an important feature. A thesis, giving the results of a piece of original work, is required.

## COURSE IN MECHANICAL ENGINEERING

FOR FIRST YEAR SEE PAGE 17

### SECOND YEAR

| First Semester | | | Second Semester | | |
|---|---|---|---|---|---|
| Mathematics<br>Calculus. | (141) | 5. | Mathematics<br>Calculus. | (142) | 5. |
| Physics<br>Mechanics and heat. | (113) | 5. | Physics<br>General Physics. | (112) | 3. |
| Engineering Drawing<br>Descriptive Geometry. | (103) | 3. | Engineering Drawing<br>Machine Sketching. | (104) | 3. |
| Shopwork<br>Foundry, Chipping, Filing. | (105) and (107) | 3. | Shopwork<br>Machine Work. | (120) | 3. |
| Shopwork<br>Adv. Pattern Making. | (111) | 2. | Physics.<br>Laboratory. | (138) | 2. |
| | | | Civil Engineering<br>Surveying. | (128) | 2. |
| Military Drill. | | 1. | Military Drill | | 1. |

### THIRD YEAR

| First Semester | | | Second Semester | | |
|---|---|---|---|---|---|
| Mechanics<br>Statics and Str. of Marter'ls. | (101) | 5. | Mechanics<br>Kinetics and Hydraulics. | (102) | 5. |
| Engineering Drawing<br>Technical Drawing. | (111) | 2. | Architecture<br>Photography. | (112) | 2. |
| Metallurgy<br>General Metallurgy. | (109) | 4. | Civil Engineering<br>Timber and Masonry. | (126) | 2. |
| Mathematics<br>Diff. Equations. | (151) | 1. | Mech. Eng.<br>Mechanism and Drawing. | (114 and 116) | 3 & 1. |
| Shopwork<br>Adv. Machine Work. | (121) | 3. | Mechanical Eng.<br>Steam Engines and Boilers. | (118) | 4. |
| Mechanical Eng.<br>Steam Power Plants. | (103) | 3. | Mechanical Eng.<br>Laboratory. | (164) | 2. |
| | | | Mechanical Eng.<br>Inspection Trip. | 130 or 134. | |

### FOURTH YEAR

| First Semester | | | Second Semester | | |
|---|---|---|---|---|---|
| Civil Engineering<br>Trusses. | (123) | 3. | *Industrial Arts<br>Shop Buildings. | (114) | 2. |
| Electrical Eng.<br>Elementary Elec. Eng. | (101) | 5. | *Mechanical Eng.<br>Steam Turbines. | (146) | 2. |
| Mechanical Eng.<br>Machine Design. | (127) | 5. | Mechanical Eng.<br>Machine Design. | (144) | 5. |
| Mechanical Eng.<br>Gas Engines and Producers. | (125) | 2. | Mechanical Eng.<br>Hydraulic Machinery. | (142) | 2. |
| Mechanical Eng.<br>Thermodynamics. | (129) | 2. | Mechanical Eng.<br>Laboratory. | (190) | 6. |
| Mechanical Eng.<br>Laboratory. | (179) | 2. | Mechanical Eng.<br>Thesis. | (148) | 3. |
| | | | Mechanical Eng.<br>Inspection Trip. | (130 or 134) | |

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*Alternative Courses. One must be taken.

Students who, for financial or other satisfactory reasons, are unable to take Mechanical Engineering (130) may substitute Mechanical Eng. (134) upon receiving permission from the head of the department.

## MINE ENGINEERING

The profession of mine engineering, which has for its main object the development and winning of mineral resources, is closely connected with that of metallurgy.

The special work in mine engineering proper begins in the second year with mine surveying in which, in addition to the instruction at the University, practice is given in actual surveying of coal mines accessible to Columbus. In the fourth year a course of lectures treats of the problems of mine engineering involved in opening, developing and equipping mining plants, and the prospecting, location and examination of mineral property and mining plants.

The special work in metallurgy begins in the second semester of the second year and comprises courses in the metallurgical laboratory, and one semester in mineralogy and crystallography. In the third year a course of lectures for two semesters treats of the principles of combustion, the valuation and the treatment of fuels, and the extraction and preparation of iron, steel, and other metals, including gold and silver. There is also work in advanced metallurgical laboratory, where special analytical methods, coal washing and ore dressing are studied by lectures and laboratory practice also calorimetry and the microscopic examination of metals. In this year there is a one-semester course in determinative mineralogy and a one-semester laboratory course in the fire assaying of gold, silver, and other ores. In the fourth year there is a course in connection with the department of mine engineering on metallurgical construction covering the design of furnaces and other metallurgical machinery, and a course of lectures on ore dressing and coal washing.

## COURSE IN MINE ENGINEERING.

FOR FIRST YEAR SEE PAGE 17

### SECOND YEAR

| FIRST SEMESTER | | | SECOND SEMESTER | | |
|---|---|---|---|---|---|
| Mathematics<br>Calculus. | (141) | 5. | Mathematics<br>Calculus. | (142) | 5. |
| Physics<br>General Physics. | (111) | 3. | Physics<br>General Physics. | (112) | 3. |
| Engineering Drawing<br>Descriptive Geometry. | (103) | 3. | Engineering Drawing<br>Machine Sketching. | (104) | 3. |
| Chemistry<br>Quantitative Analysis. | (119) | 3. | Chemistry<br>Chemical Problems. | (124) | 1. |
| Mine Engineering<br>Mine Surveying. | (103) | 5. | Metallurgy<br>Laboratory. | (106) | 4. |
| | | | Metallurgy<br>Mineralogy and Cyrst'l'g'phy. | (104) | 2. |
| Military Drill | | 1. | Military Drill | | 1. |

### THIRD YEAR

| | | | | | |
|---|---|---|---|---|---|
| Mechanics<br>Statics and Str. of Mater'ls. | (101) | 5. | Mechanics<br>Kinetics and Hydraulics. | (102) | 5. |
| Metallurgy<br>Gen. Metallurgy. | (109) | 4. | Metallurgy<br>Gen. Metallurgy. | (110) | 4. |
| Metallurgy<br>Fire Assaying. | (105) | 3. | Metallurgy<br>Calorimetry, Mine Gas Anal. | (112) | 2. |
| Metallurgy<br>Laboratory. | (107) | 4. | Metallurgy<br>Determinative Mineralogy. | (108) | 3. |
| Geology<br>Gen. Geology. | (165) | 3. | Geology<br>Petrography. | (166) | 2. |
| | | | Civil Engineering<br>Trusses. | (124) | 3. |

### FOURTH YEAR

| | | | | | |
|---|---|---|---|---|---|
| Mine Engineering<br>General Mining. | (105) | 5. | Mine Engineering<br>Gen. Mining. | (106) | 5. |
| Metallurgy<br>Metallurgical Const. | (111) | 2. | Mine Engineering<br>Plans and Specifications. | (104) | 4. |
| Metallurgy<br>Ore Dressing. | (113) | 2. | Metallurgy<br>Metallography, etc. | (114) | 3. |
| Electrical Eng<br>Elementary Elec. | (103) | 2. | Mechanical Eng.<br>Laboratory. | (192) | 3. |
| Geology<br>Economic Geology. | (167) | 3. | *Mine Engineering<br>Thesis. | (116) | 3. |
| Architecture<br>Photography. | (111) | 2. | *Metallurgy<br>Thesis. | (116) | 3. |

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*Alternative courses. One must be taken.

## COMBINATION COURSES.

Combination courses, leading to two engineering degrees, can be arranged for any two of the foregoing degrees. The amount of additional time will be at least thirty semester hours in excess of that required for one, and may be more. In no case will the student be required to take all of the work not common to the two courses as published.

For instance, a joint course Mechanical and Electrical Engineering can be made in five years. Between courses more unlike, such as Civil Engineering and Mechanical Engineering, six years would be required.

## ARTS-ENGINEERING COURSES.

For the benefit of those who desire to possess the advantage of a wider general culture and a broader foundation than can be given in the limits of a four-year professional course, a combination of three years in the College of Arts, Philosophy and Science and three years in the College of Engineering can be so adjusted as to enable both the Bachelor of Arts and Bachelor of the appropriate Engineering courses to be taken. Negotiations are now in process with other institutions of approved standing in Ohio, seeking to establish the same relations with them.

## GRADUATE WORK

The University is now organizing a Graduate School which is to have administrative control of the whole subject of Graduate work in all of the Colleges of the University. The College of Engineering has formulated a plan for graduate work in engineering, and the granting of the professional or engineer's degree, which will be submitted to the Council of the Graduate School when it is duly constituted. Pending the acceptance of this plan by the Council, no binding statement can be made as to the terms under which such work can be done. The following is the plan proposed by the College of Engineering:—

"*Graduate Courses.* All of the departments now offering courses leading to a Bachelor degree are also prepared to offer one or more advanced or graduate courses, which may form the major subjects in an additional year's work leading to a Master's degree. Two or more minor courses, chosen from such cognate engineering work as would most strengthen the grasp and broaden the view of the student in the special line of his study would be assigned. These minors may not be courses of graduate rank. On the successful completion of a year's work of not less than thirty semester hours and the submission of an acceptable thesis embodying the results of an original investigation in some phase of engineering or applied science, the appropriate Master's degree will be conferred."

"*Professional Degrees.* The professional degree will in no case be conferred upon the basis of academic training only. The Council of the Graduate School may award the professional or engineer's degree to any person holding a bachelor's degree from this College, after four years of successful professional work in positions of acknowledged responsibility, and the submission of an acceptable thesis. The Council may on proper grounds, remit the requirement of a thesis.

In the case of persons holding the Master's degree from this College, the term of successful professional experience required may be reduced to two years, and in case of holders of the Bachelor's degree from this College returning to the College after one or more years of successful professional work, the Engineer's degree may be conferred at once upon the completion of an additional year's residence in the pursuit of graduate study, in lieu of the Master's degree."

## COURSES NOT LEADING TO A DEGREE

The following short courses, of two years each, are offered by the College of Engineering to meet the needs of that class of young men who have for some reason failed to qualify themselves to enter the regular four year courses, but whose experience in engineering work has shown them the need of some technical education as a requisite to further progress. These courses are in no sense a substitute for the regular four-year courses, nor are they designed as preparation for subsequent entrance into the regular courses. They aim to give an introduction to the fundamentals of engineering only, and in the shortest time consistent with any real educational result.

Applicants for admission to these courses are required to have at least two years of consecutive practical experience in some branch of the industries related to the one they wish to pursue, and to present satisfactory certificate to that effect. (See page 15.)

## SHORT COURSE IN CLAYWORKING

### FIRST YEAR

| First Semester | | | Second Semester | | |
|---|---|---|---|---|---|
| Mathematics<br>Elementary Algebra. | (101) | 5. | Mathematics<br>Elementary Algebra. | (102) | 5. |
| Mathematics<br>Plane and Solid Geom. | (113) | 5. | Mathematics<br>Solid Geom. and Trig. | (114) | 5. |
| Chemistry<br>Elementary Chemistry. | (101) | 4. | Chemistry<br>Elementary Chemistry and Qualitative Analysis. | (102) | 4. |
| Engineering Drawing<br>Freehand and Lettering. | (113) | 4. | Engineering Drawing<br>Mechanical Drawing. | (114) | 3. |
| Military Drill | | 1. | Military Drill | | 1. |
| Gymnasium | | 1. | Gymnasium | | 1. |

*Summer Session—Students are required to take two of the following subjects: Shopwork (107) (109) and (115,) during the Summer Session at the close of the first year.

### SECOND YEAR

| | | | | | |
|---|---|---|---|---|---|
| Ceramic Engineering<br>Ceramic Chemistry. | (101) | 5. | Ceramic Engineering<br>Clay Manufacture. | (104) | 5. |
| Ceramic Engineering<br>Clay Manufacture. | (103) | 5 | Ceramic Engineering<br>Glazes and Colors. | (110) | 2. |
| Ceramic Engineering<br>Laboratory. | (115) | 2. | Ceramic Engineering<br>Laboratory. | (112) | 5. |
| Physics<br>Elementary Physics. | (101) | 6. | Ceramic Engineering<br>Ceramic Calculations. | (106) | 2. |
| | | | Ceramic Engineering<br>Lab. in Calculations. | (120) | 1. |
| | | | Ceramic Engineering<br>Dryer and Kiln Design. | (122) | 2. |
| Military Drill | | 1. | Military Drill | | 1. |

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*Upon presentation of reasons satisfactory to the head of the department, students may substitute work in a ceramic factory for the above shopwork courses.

## SHORT COURSE IN INDUSTRIAL ARTS

### FIRST YEAR

| First Semester | | | Second Semester | | |
|---|---|---|---|---|---|
| Mathematics<br>Elementary Algebra. | (101) | 5. | Mathematics<br>Elementary Algebra. | (102) | 5. |
| Mathematics<br>Plane and Solid Geom. | (113) | 5 | Mathematics<br>Solid Geom. and Trig. | (114) | 5. |
| Engineering Drawing<br>Freehand and Lettering. | (113) | 4. | Engineering Drawing<br>Mechanical Drawing. | (114) | 3. |
| Shopwork<br>Pattern Making. | (109) | 2. | Shopwork<br>Adv. Pattern Making. | (112) | 2. |
| Shopwork<br>Forging. | (115) | 2. | Shopwork<br>Foundry, Chipping, Filing. | (106 and 108) | 3. |
| Military Drill | | 1. | Military Drill | | 1. |
| Gymnasium | | 1. | Gymnasium | | 1. |

### SECOND YEAR

| | | | | | |
|---|---|---|---|---|---|
| Engineering Drawing<br>Descriptive Geometry. | (103) | 3. | Engineering Drawing<br>Machine Sketching. | (104) | 3. |
| Industrial Arts<br>Machines. | (101) | 3. | Industrial Arts<br>Machines. | (102) | 3. |
| Industrial Arts<br>Designing. | (103) | 2. | Industrial Arts<br>Designing. | (104) | 2. |
| Physics<br>Elementary Physics. | (101) | 6. | Industrial Arts<br>Strength of Materials. | (110) | 6. |
| Shopwork<br>Machine work. | (119) | 3. | Shopwork<br>Adv. Machine Work. | (122) | 3. |
| Military Drill | | 1. | Military Drill | | 1. |

## SHORT COURSE IN MINING

### FIRST YEAR

| First Semester | | | Second Semester | | |
|---|---|---|---|---|---|
| Mathematics<br>Elementary Algebra. | (101) | 5. | Mathematics<br>Elementary Algebra. | (102) | 5. |
| Mathematics<br>Plane and Solid Geom. | (113) | 5. | Mathematics<br>Solid Geom. and Trig. | (114) | 5. |
| Physics<br>Elementary Physics. | (101) | 6. | Shopwork<br>Forging. | (116) | 2. |
| | | | Geology<br>Elementary Physiography. | (162) | 4. |
| Military Drill | | 1. | Military Drill | | 1. |
| Gymnasium | | 1. | Gymnasium | | 1. |

### SECOND YEAR

| | | | | | |
|---|---|---|---|---|---|
| Engineering Drawing<br>Freehand and Lettering. | (113) | 4. | Engineering Drawing<br>Mechanical Drawing. | (114) | 3. |
| Chemistry<br>Elementary Chemistry. | (101) | 4. | Geology<br>Elementary Geology. | (164) | 3. |
| Mine Engineering<br>Mine Plans. | (107) | 2. | Metallurgy<br>Water Supply and Mine Gases. | (102) | 4. |
| Mine Engineering<br>Mine Surveying, | (101) | 5. | Mine Engineering<br>General Mining. | (102) | 5. |
| Military Drill | | 1. | Military Drill | | 1. |

# GROUNDS AND BUILDINGS

The grounds of the University are located about two miles north of the Union Station and extend west from High Street for nearly a mile. They may be reached by the car lines on either High Street or Neil Avenue. The campus proper lies along High Street and contains about one hundred acres. To the west of this lies the University farm which, combined with the campus, has an area of 439 acres. As seen from the map (page 2) the twenty-nine larger buildings, valued at over one and a quarter million dollars, are irregularly arranged near the center of the campus, leaving a roughly oval space in the center. Three of the buildings, Brown Hall, the School of Mines, and the Robinson Laboratory, are used exclusively for the work of the College of Engineering and are located near each other and near the power plant in the northwestern portion of the grounds. Besides these, the three other buildings described below are largely used by the students of this college, and others to a less degree.

A bulletin containing views of the buildings and laboratories in which engineering instruction is given may be obtained by addressing the University Editor.

## BROWN HALL

Of the three buildings which are entirely occupied with the work of the college, the oldest is Brown Hall, a handsome brick structure named after the second Dean of the College of Engineering. This building was completed in 1904 at a cost of $75,000. The main part of this building is 217 by 50 feet, and there are two short wings extending to the rear. It accommodates the departments of Architecture, Civil Engineering, and Engineering Drawing.

## THE SCHOOL OF MINES

This building was completed in 1906, and cost $85,000. It is 270 feet long by 70 feet wide with two one-story fireproof wings for the accommodation of furnace work. This building accommodates the departments of Ceramic Engineering, Metallurgy, Mechanics and Mine Engineering. The basement, which is wholly above grade, is used for laboratories and there are also a number of laboratories on the first and second floors. These floors accomodate the lecture rooms, drawing rooms, and offices also.

## THE ROBINSON LABORATORY

This is a building of modern shop construction with sawtooth roof, made up of one forty-eight-foot and seven thirty-foot divisions. These, together with enclosed galleries at the sides, make a total length of 310 feet, with a depth of 112 feet. The enclosed galleries and the space under them are used for special laboratories, museums, classrooms, and offices. The central sections are lighted by skylights with northern exposure, and are occupied by the different laboratories of the Mechanical and Electrical Engineering departments, and by an amphitheatre suitable for demonstration work, which is used by both departments. This building, which has just been completed, cost $75,000, exclusive of equipment, and is one of the most practical laboratory buildings in the country. It is named in honor of Dr. Stillman W. Robinson, first professor of Mechanical Engineering in this University.

## HAYES HALL

This building was named in honor of President Rutherford B. Hayes, at one time a trustee of the University. It is at present occupied by the departments of Industrial Arts and Domestic Science. This building, which was completed in 1893, is irregular in shape, with a frontage of 166 feet and greatest depth of 144 feet. The central section of the building is occupied by the machine and carpenter shops, foundry, forge room, offices and drawing rooms. The shop equipment is given on page 64.

## CHEMISTRY HALL

In this building is given all the instruction in pure chemistry, and also the technical courses in chemical engineering. The building was completed in 1907, at a cost of $100,000. It has a frontage of 200 feet and a depth of 70 feet, with laboratories, lecture rooms, offices, etc. occupying two stories and a high basement. (See also Chemical Engineering). It has one of the finest equipments in the University.

## PHYSICS HALL

This building is devoted to the work of the Physics Department. It is 105 feet long by 102 feet in its greatest depth, with three stories and a high basement. It was recently erected at a cost of $80,000, and is equipped with forty thousand dollars worth of modern apparatus. A large part of the basement is given to the laboratory work in electrical measurements.

## OBSERVATORY

The Emerson McMillin Observatory is the gift of Emerson McMillin of New York City. It is located in the southern part of the grounds, and is provided with excellent equipment for purely scientific research, or for the teaching of astronomy in its engineering aspects.

## ORTON HALL

This building was erected for the Department of Geology and represents in itself the building stones of Ohio, most of the characteristic varieties of which were used in its construction. The University Library is temporarily located here, but a fine Library building to cost $250,000 is in process of construction. For the equipment, see Geological Department.

## UNIVERSITY HALL

In this building, which is the oldest on the grounds, the greater part of the work in mathematics and language is given. This building also contains the office of the President, the Secretary of the Board of Trustees, and the Registrar.

## POWER HOUSE

The University provides the light, heat and power for all of its buildings from a central station. There is a boiler house 38 by 100 feet, with four 150, one 450, and one 500 horse-power watertube boilers, equipped with turbine, steam-driven feed pumps, automatic stokers, and coal and ash-handling apparatus. Fuel is brought to the University over a spur from the Hocking Valley Railway, about three-quarters of a mile long. The cars are unloaded by a locomotive crane, with clam-shell unloader. The coal is dropped by this apparatus into the chutes of the coal-handling system, which carries it to the boilers, or is dumped in concrete coal-storage bins, 40 by 100 feet in area. Near the boiler house is the engine house, 40 by 60 feet, with an L, 30 by 40 feet, equipped with the following: Two 125 kilowatt two-phase direct-connected steam units, one 100 kilowatt gas engine unit, one 300 kilowatt turbo-generator set, one 15 kilowatt exciter set, and two small air compressors; the hot water heating apparatus located in the L utilizes exhaust steam for heating eight buildings, and consists of the following: One large exhaust heater, one live steam heater, one turbine pump, and one surface condenser. The power and boiler houses are connected through a large tunnel with nearly all the buildings of the University, and through this tunnel run the pipes for steam, water, and gas, as well as the electrical distribution system for light and power. The power plant is a strictly modern and efficient equipment, and of value as an object lesson to all students of engineering.

Besides the above buildings, students in the College of Engineering use the Gymnasium for Physical Training and Military Drill, and various other buildings to a less degree.

# THE DEPARTMENTS OF INSTRUCTION

## ARCHITECTURE

(Office, Room 22, Brown Hall)

PROFESSOR BRADFORD, ASSOCIATE PROFESSOR CHUBB, MR. HASKETT

### EQUIPMENT

The department occupies the west end of Brown Hall, where it is provided with large, well lighted designing rooms, a lecture room with projection lantern, library, and office.

In the designing rooms, each student is provided with a drawing table and locker for his exclusive use. The equipment includes a fine collection of plaster casts of architectural orders, carved ornament and statuary, including a set by Caproni from the noted monuments of ancient and mediæval architecture, two thousand lantern slides of the masterpieces of architecture, a collection of large photographs, a collection of portfolios of noted architectural plates, drawings and specifications of erected structures, samples of building materials, fixtures, etc. The library has a good collection of standard works and bound volumes of the standard periodicals.

The courses in photography are given in this department. The laboratory for this work is one of the best in the country and includes a dark room which will accommodate forty students working at the same time, each with a complete and separate stall. There is a printing and toning room, and also a room for indoor and special work. Equipment of note consists of fourteen high-grade view cameras fitted with fine lenses, also shutters, color screens, and exposure meters, a Bausch and Lomb photo-micrographic apparatus of the finest quality, special photographic arc lamps, and three copying cameras. There is an enlarging room equipped for handling any work up to the largest practical sizes, and also a separate blue printing room equipped with a modern cylindrical arc lamp, blue printing machine, also washing tanks, drying racks, etc.

### SUBJECTS IN WHICH INSTRUCTION IS OFFERED.

**101. History of Architecture**. Three credit hours. Architecture, second year, first semester.

Lectures, illustrated by lantern slides.

**102.** Continuation of 101. Architecture, second year, second semester.

**103. Order Problems.** Two credit hours. Architecture, second year, first semester. Prerequisite, Engineering Drawing 102, Concurrent with Engineering Drawing 107.

Drawing details of the Orders.

**104. Order Problems.** Five credit hours. Architecture, second year, second semester. Prerequisite, Architecture 103.

**107. Design.** Five credit hours. Lectures and practice. Architecture, third year, first semester. Prerequisite, Architecture 104, and concurrent with Architecture 113.

**108. Design.** Four credit hours. Architecture, third year, second semester. Prerequisite, Architecture 107.

**109. Decoration and Ornament.** Three credit hours. Architecture, third year, first semester. Prerequisite, Architecture 104 and Engineering Drawing 115.

**110. Working Drawings.** Four credit hours. Architecture, third year, second semester. Prerequisite, Architecture 107.

**111. Photography.** Two credit hours. Civil Engineering, third year, first semester; Mine Engineering, fourth year, first semester. Prerequisite, Chemistry 105, 106, or 109, 110.

**112. Photography.** Two credit hours. Mechanical Engineering and Architecture, third year, second semester. Prerequisite, Chemistry, 105, 106, or 109, 110.

**113. Principles of Architectural Composition.** Two credit hours. Architecture, third year, first semester. Concurrent, Architecture 109.

**114. Designing.** Three credit hours. Architecture, fourth year, second semester. Prerequisite, 108.

**115. Designing.** Six credit hours. Architecture, fourth year first semester. Prerequisite, Architecture 108.

**116. Professional Practice.** Four credit hours. Architecture fourth year, second semester. Prerequisite, Architecture 115.

**117. Sanitary Plumbing.** One credit hour. Architecture, fourth year, first semester.

**118. Thesis.** Five credit hours. Architecture, fourth year, second semester.

**119. Masonry.** Two credit hours. Architecture, fourth year first semester. Prerequisite, Architecture 110.

**120. Summer Work.** The equivalent of four weeks of work in an architect's office, or a proplem in design, assigned by the department. Between the second and third years.

**121. Summer Work.** The equivalent of four weeks work in an architect's office, or a problem in design, assigned by the department. Between the third and fourth years.

**122. Photography.** Two credit hours. Second semester. Prerequisite, Architecture 111 or 112.

**124. Shades, Shadows and Perspective.** Three credit hours. Architecture, second year, second semester. Prerequisite, Engineering Drawing 107.

# ASTRONOMY

(Office, Emerson McMillin Observatory)

PROFESSOR H. C. LORD, ASSOCIATE PROFESSOR MANSON

## EQUIPMENT

The equipment consists of six sextants, two small theodolites, five chronometers, a Riefler standard clock and 2½-inch zenith telescope, by Troughton & Simms; for accurate time or longitude there is provided a 3-inch combined portable transit and zenith telescope by Saegmuller, and chronograph by Warner & Swasey. For refined azimuth determination there is a theodolite by Troughton & Simms, equipped with 12-inch horizontal and vertical circles, reading to single seconds of arc.

Further equipment comprises a 12½-inch equatorial telescope with mounting by Warner & Swasey, objective by Brashear, and a Universal star spectroscope by Brashear; a position micrometer by Warner & Swasey; a 4-inch portable equatorial by Alvan Clark; comparator by Zeiss, and a set of meteorological instruments. A 2-horse power gas engine, dynamo and a large storage battery are also provided.

Ten students can work each clear night under constant supervision of the instructor, the inconvenience of open air observations being reduced to a minimum.

## SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**104. Astronomy, Geodesy, and Least Squares.** Three credit hours. Civil Engineering, third year, second semester. Prerequisite, Mathematics 142.

**105.** Continuation of 104. Three credit hours. Civil Engineering, fourth year, first semester.

# CERAMIC ENGINEERING

(Office, Room 131, Mines Building)

PROFESSOR ORTON, PROFESSOR PURDY, ASSISTANT PROFESSOR STALEY, MR. HARROP, MR. POTTS.

## EQUIPMENT

The Department of Ceramic Engineering occupies the western third of the School of Mines Building. In the basement are a pottery laboratory, a brick machine room, and a room chiefly devoted to the grinding of dry materials. There is also a large store room, and in an attached fireproof wing a kiln room. On the first floor, besides offices and class rooms, there is a chemical laboratory and a museum of ceramic products. On the second floor are rooms for physical testing and measurement, advanced thesis work, and drawing.

The facilities of the department comprise a chemical laboratory equipped for forty students and especially suited for mineral analysis, a mechanical outfit for the preparation of clays for pottery manufacture, and the production of the ware itself; machinery for grinding and tempering clays; a plant for the manufacture of brick, tiles, pipes, and hollow goods; a kiln house equipped with three downdraft kilns, using solid fuel, and two Caulkins muffle kilns arranged to fire with either oil or gas, and several small furnaces for burning cements, testing refractory materials, melting glass, and making fritts, using compressed air and natural gas; an electric furnace for high temperature work. The lecture room is equipped with a series of wall charts, cases containing a mineral collection and a large number of American and foreign clays, a collection of upwards of five hundred lantern slides illustrating the occurrence, preparation, and manufacture of clays. A ceramic museum containing a small collection of pottery and clay products has been assembled, mostly by donation. A library of the best literature on ceramic technology, containing about four hundred volumes, is open to the students daily from 8 A. M. to 10 P. M.

## SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**101. Ceramic Chemistry.** Five credit hours. Ceramic Engineering and Short Clay-working, second year, first semester. Prerequisite, Chemistry 106 or 110.

Quantitative analysis of limestone and simple minerals.

**102. Ceramic Chemistry.** Three credit hours. Ceramic Engineering, second year, second semester. Prerequisite, Ceramic Engineering 101. Quantitative analysis of clays, fire gases, etc.

**103. Ceramic Manufacture.** Five credit hours. Ceramic Engineering, third year, first semester; Short Clay-working, second year, first semester. Origin, occurrence, constitution, properties and methods of winning ceramic material.

**104.** Continuation of 103. Five credit hours. Ceramic Engineering, third year; Short Clay-working, second year, second semester.

General principles of manufacture of clay wares; theory and practice of drying and burning.

**106. Ceramic Calculations.** Two credit hours. Ceramic Engineering and Short Clay-working, second year, second semester. Prerequisite, Ceramics 101.

Calculations involved in blending of ingredients used in ceramic mixtures; determinations of limits of variation in given series; limits of errors; volume calculations; problems in heat.

**108. Physical and Chemical Measurements of Clays.** Three credit hours. Ceramic Engineering, third year, second semester.

Application of physical chemical laws to fusions of mineral mixtures; determination of melting points; deformation periods; relative viscosity of fused magmas; study of influence of salts on viscosity of slips, etc.

**110. Colors and Glazes.** Two credit hours. Ceramic Engineering, third year, second semester; Short Clay-working, second year, second semester. Prerequisite, Ceramics 101 and 103.

The decoration of clay wares by glazing and coloring. This course deals with decoration from the technological side only, not touching upon the artistic.

**111. Laboratory Work in Ceramics.** Five credit hours. Ceramic Engineering, fourth year, first semester.

Practice in clay testing and measurement of physical properties of clays; the production of bodies made from single clays and of clays with minerals. In each case the bodies are burned and tested.

**112.** Continuation of 111. Five credit hours. Ceramic Engineering, fourth year, second semester; Short Clay-working, second year, second semester.

The production of slips, engobes, and glazes, and the study of the methods of coloring.

**113. Ceramic Designing.** Two credit hours. Ceramic Engineering, fourth year, first semester. Prerequisite, Ceramics 104.

Designing, estimating cost of and writing specifications for kilns and dryers.

**114.** Continuation of 113. Three credit hours. Ceramic Engineering, fourth year, second semester.

The work started in Ceramics 113 will be extended to the design and equipment of clay-working plants.

**115. Laboratory Work in Ceramics.** Two credit hours. Short Clay-working, second year, first semester. Concurrent, Ceramics 103.

Testing of clays and minerals employed in clay manufacture and in blending of same for ceramic purposes.

**116. Thesis.** Four credit hours. Ceramic Engineering, fourth year, second semester.

**118. Cement Manufacture.** Five credit hours. Alternative with Ceramics 112. Ceramic Engineering, fourth year, second semester. Prerequisites, 102 and 104.

The theory of hydraulicity, the compounding, manufacture, and testing of natural and Portland cements and other hydraulics.

**120. Laboratory Drill in Ceramic Calculations.** One credit hour. Short Clay-working, second year, second semester.

**122. Dryer and Kiln Design.** Two credit hours. Short Clay-working, second year, second semester. Concurrent with Ceramics 106.

A graphic study of dryer and kiln design.

**124. Advanced or Research Work.** Three to five credit hours. Time to be arranged.

This course is given to furnish opportunity for advanced studies along special lines or investigations in the various fields of clay, cement or glass manufacture. Prerequisite, Ceramic Engineering 112, and 108.

# CHEMISTRY

(Office, Chemistry Hall)

PROFESSOR MCPHERSON, EMERITUS PROFESSOR NORTON, PROFESSORS HENDERSON, FOULK AND EVANS, ASSOCIATE PROFESSOR WITHROW, DR. WILKINSON, MR. KELLOGG, AND DEPARTMENT ASSISTANTS

## EQUIPMENT

The Department of Chemistry occupies the greater part of Chemistry Hall. In the basement are two laboratories, each accommodating 400 students in elementary chemistry. There are also laboratories for industrial chemistry, for organic combustion work and a repair shop. On the first floor are the main office of the department,a large laboratory for organic chemistry accommodating seventy-five students, a smaller one for research work, a lecture room, a library and a main store room where all the laboratory and office supplies of the University are kept in stock.

On the second floor is the main lecture room, having a seating capacity of 300, and equipped with lantern, specimens, etc., for demonstration work. On this floor are laboratories for the following lines of work: Physical chemistry, general analytical work, advanced inorganic chemistry, and the chemical investigation of water. There are also three small private laboratories, the balance room, a small lecture room, and the electrical room, containing the storage batteries, a mercury rectifier, and switchboard. On the upper floor are three recitation rooms. The apparatus for ventilating the hoods and the large still for furnishing distilled water are also located here.

The department is well equipped with all the necessary apparatus for carrying on not only the elementary work in chemistry, but advanced and research work as well. The general chemical apparatus is loaned to the student, and no charge is made if it is returned in good order. The laboratories are supplied with all the modern conveniences, and each student has his own locker in which he keeps his apparatus. The storage battery room is connected with the various laboratories so that the current can be utilized wherever needed.

## SUBJECTS IN WHICH INSTRUCTION IS OFFERED.

**101. Elementary Chemistry.** Four credit hours. First semester, one lecture, one quiz, six hours laboratory weekly. Short Mining, second year. Short Clayworking, first year.

A general introductory course on the chemistry of the non-metals. It is distinctly elementary in character and is arranged for students in short courses only. No credit is allowed for it in the regular four year courses. Students taking this course should follow with course 102, second semester.

**102. Elementary Chemistry and Qualitative Analysis.** Continuation of Chemistry 101. Short courses. Second semester.

A general introductory course on the chemistry of the metals. The laboratory work deals with the elementary principles of qualitative analysis. The course is arranged for students in short courses only. No credit is allowed for it in the regular four year courses.

**105. Elementary Chemistry.** Four credit hours. First semester. One lecture, one quiz, and six hours laboratory weekly. Taken by first year students in all four year courses who have not presented chemistry for entrance requirement. A general course in the chemistry of non-metals.

**106. Elementary Chemistry and Qualitative Analysis.** A continuation of Chemistry 105. Four credit hours. Second semester.

A general course in the Chemistry of the metals. The laboratory work accompanying is a general introductory course in qualitative analysis.

**109. General Chemistry.** Four credit hours. First semester. One lecture, one quiz, and six hours laboratory weekly. Taken by first year students in all four year courses who have presented Chemistry as an entrance requirement. A general course on the chemistry of non-metals.

**110. General Chemistry and Qualitative Analysis.** A continuation of Chemistry 109. Four credit hours. Second semester.

A general course in the chemistry of the metals. It is more advanced than Chemistry 106. The laboratory work is a general course in qualitative analysis.

**113. Advanced General Chemistry.** Two credit hours. Two lectures weekly. Chemical Engineering, second year, first semester. Prerequisite, Chemistry 106 or 110.

A course on the fundamental topics of Advanced General Chemistry.

**114. Advanced General Chemistry.** A continuation of Chemistry 113. Two credit hours. Chemical Engineering, second year, second semester.

**117. Qualitative Analysis.** Three credit hours. First semester. One lecture and six hours laboratory weekly. Time to be arranged. Prerequisite, an acceptable course in general chemistry.

**119. Quantitative Analysis.** (a) Three credit hours. One lecture and six hours laboratory weekly. Mine Engineering, second year, first semester. (b) Four credit hours. One lecture and nine hours laboratory weekly. Chemical Engineering, second year, first semester. Prerequisite, Chemistry 106 or 110.

The elementary principles of gravimetric and volumetric analysis

**120. Quantitative Analysis.** Four credit hours. One lecture and nine hours laboratory weekly. Chemical Engineering, second year, second semester. Prerequisite, Chemistry 119. A continuation of Chemistry 119 with typical analytical methods in gravimetric and volumetric analysis. This course must be accompanied by Chemistry 124. It is desirable that it be accompanied bv Chemistry 114.

**124. Chemical Problems.** One credit hour. Chemical Engineering, second year, second semester.

Extended practice in the solution of problems pertaining to gravimetric and volumetric analysis. This course is arranged to accompany Chemistry 120.

**136. The Reading of Chemical Literature.** Two credit hours. Chemical Engineering, elective, third year, second semester. Prerequisite, one year of German.

The object of this course is to afford practice in the rapid reading of German chemical literature, the selections being made with special reference to the technical terms of the science.

**140. Thesis.** Four credit hours. Chemical Engineering, fourth year, second semester.

**151. Organic Chemistry.** Two credit hours. Two lectures weekly. Chemical Engineering, third year, first semester. Prerequisite, Chemistry 114 and 120.

General course in Organic Chemistry.

**152.** Continuation of 151. Two credit hours. Two lectures weekly. Chemical Engineering, third year, second semester. Prerequisite. Chemistry 151.

**153. Organic Chemistry.** Two or three credit hours. Six or nine hours laboratory weekly. Chemical Engineering, third year, first semester. Must be accompanied or preceded by Chemistry 151.

A general course in the preparation of typical organic compounds.

**154.** Continuation of 153. Two or three credit hours. Six or nine hours laboratory weekly. Chemical Engineering, elective third year, second semester. Must be preceded or accompanied by Chemistry 152.

**157. Physical Chemistry.** Three credit hours. Three lectures weekly. Chemical Engineering, fourth year, first semester, and Ceramic Engineering, third year, first semester. Prerequisite, Chemistry 114, 120, and 152.

This is a general course in Physical Chemistry.

**158. Physical Chemistry**. Three credit hours, Three lectures weekly. Chemical Engineering, fourth year, second semester. Ceramic Engineering, third year, second semester. Prerequisite, Chemistry 157.

**162. Physical Chemistry.** Two or three credit hours. Six or nine hours laboratory weekly. Elective, second semester.

**168. Qualitative Analysis.** Advanced course. Three to five credit hours. One lecture, six to twelve hours laboratory weekly. Chemical Engineering, elective third year, second semester. Prerequisite, Chemistry 120, or equivalent.

Extended work in general qualitative analysis including the more important of the rare elements.

**176. Sanitary Analysis.** Three credit hours. Two lectures and three hours laboratory weekly. Chemical Engineering, elective third year, second semester. Prerequisite, Chemistry 120, or equivalent.

A study of the methods of sanitary water analysis and interpretation of results.

**177. Industrial Chemistry.** Two credit hours. First semester. Two lectures weekly. Prerequisite, Chemistry 113-114 and 153-154.

A general course in the principles underlying the application of chemistry in the industries.

**178. Industrial Chemistry.** One credit hour. Second semester. One lecture weekly. Prerequisite, Chemistry 177.

**182. Industrial Inspection Trip.** A four to six day excursion at a suitable time in connection with 177-178 for the inspection of industrial chemical processes in actual operation. The entire expense varies from $15 to $30. A satisfactory report on the work inspected is required.

**184. Written Reports**. A course of assigned reading upon some industrial chemical process and a written report on same. This is a substitute for Chemistry 182, but the substitution is only allowed upon presentation of reasons satisfactory to the instructor in charge.

**185. Industrial Chemistry.** Two credit hours. One conference, five hours laboratory work weekly. Prerequisite, Chemistry 119-120. Prerequisite or Concurrent, 177. A course in industrial chemical research.

**186. Industrial Chemistry.** Three credit hours. One conference, eight hours laboratory work weekly. Prerequisite, Chemistry 119-120. Prerequisite or Concurrent, Chemistry 177-178. A course of industrial chemical research and technical analysis.

**187. Inorganic Preparations.** Two or three credit hours. Six or nine hours laboratory weekly. Chemical Engineering, elective third year, first semester. Prerequisite, Chemistry 114. A course in the preparation of a limited number of compounds chosen so as to give practice in the different kinds of manipulation involved in the preparation of inorganic compounds.

**188.** Repetition of 187.

**191. Rare Elements.** Two credit hours. Two lectures weekly. Elective, second semester. Given biennially. Not given 1911-12. Prerequisite, Chemistry 114 and 120.

A general course on the chemistry of the rare elements, including a discussion of their increasing economic importance.

**194. Applied Electro-Chemistry.** Two credit hours. Two lectures weekly. Elective, second semester, Prerequisite, Chemistry 158, except by the special permission of the instructor.

A descriptive course covering the application of the Electric Current in chemical industries.

**197. Special Methods of Analysis.** Three to five credit hours. First semester. One lecture and six to twelve hours laboratory work weekly. Chemical Engineering, elective, third year. Prerequisite, Chemistry 119-120.

Selections may be made from gas analysis, microchemical analysis and spectrum analysis. Time to be arranged.

# CIVIL ENGINEERING

(Office Room 33, Brown Hall)

PROFESSOR SHERMAN, PROFESSOR ENO, PROFESSOR MORRIS, ASSISTANT PROFESSOR SCHLAFLY, ASSISTANT PROFESSOR CHAMBERLIN, MR. HINKLE, MR. STERTZBACH.

## EQUIPMENT

The department occupies the eastern half of Brown Hall. For drafting, three spacious and well-lighted drawing rooms are provided for the work of the second, third, and fourth-year students, respectively. In each room is a collection of working drawings, prints, maps, etc., gathered from practicing engineers, and arranged in suitable file cases for ready consultation by the student. A large blue-print room on the ground floor is equipped with electrical blue-print apparatus, in addition to the ordinary sunlight frames.

For field work, the instruments are one theodolite, eighteen transits fitted for various kinds of surveying, thirteen leveling instruments, plane table, solar compass, solar attachments, high-grade aneroid barometers, drainage levels, surveying camera, rods, chains, tapes, hand-levels, etc. Two current meters with accessories, and a rating course 175 feet long in the rear of the building furnish facilities for carrying on hydrographic work.

The cement-testing laboratory is fitted with necessary appliances for making the ordinary tests. It contains Fairbanks and Riehle tensile testing machines briquette molds, sieves, apparatus for making hot tests, etc., and a machine for testing plain and reinforced concrete beams.

The department also owns a complete outfit for carrying on the work of summer surveying in camp.

## SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**101. Land Surveying.** Four credit hours. Four recitations weekly. Civil Engineering, second year, first semester. Prerequisite, Mathematics 132, Engineering Drawing 102.

Care and use of instruments. Farm, City, and Hydrographic Surveying.

**101a. Field Practice.** One credit hour. Three hours per week in field. Civil Engineering, second year, first semester. Prerequisite, concurrent Civil Engineering 101. Field exercises in use of instruments, and surveying.

**102. Railroad Surveying.** Three credit hours. Three recitations per week. Civil Engineering, second year, second semester. Prerequisite Civil Engineering 101 and 101 a. Simple, compound, and transition curves, frogs, switches, and earthwork.

**102a. Field Practice.** One credit hour. Three hours per week in field. Civil Engineering, second year, second semester. Prerequisite, concurrent Civil Engineering 102. Field practice in laying out curves, frogs, switches, and earthwork.

**103. Topographic Drawing.** Two credit hours, six hours per week in drafting room. Civil Engineering, second year, first semester. Prerequisite, Engineering Drawing 102. Exercises in black ink and color topographic drawing.

**104. Summer Surveying Camp.** Civil Engineering at close of second year. Prerequisite, Civil Engineering 101 a, and 102 a.

Four weeks of six days per week of ten hours per day, from the middle of June to the middle of July.

**105. Topographic Surveying.** Three credit hours. Nine hours per week in field or drawing room. Civil Engineering, third year, first semester. Prerequisite, Civil Engineering 101, 102, and 104.

Field and office work in four or five kinds of topographic surveying.

**106. Roads and Streets.** Three credit hours. Three recitations weekly. Civil Engineering, third year, second semester. Prerequisite, Civil Engineering 102, and 104.

**107. Stereotomy.** Three credit hours. Recitations, lectures, and drawing. Civil Engineering, third year, first semester. Prerequisite, Engineering Drawing 106.

**108. Timber Construction.** Three credit hours. Lectures and drawing. Civil Engineering, third year, second semester. Prerequisite, Engineering Drawing 105, Concurrent Mechanics 102.

**109. Sanitary Engineering.** Two credit hours. Two recitations per week. Civil Engineering, third year, first semester. Prerequisite. Civil Engineering 102, and 104.

**110. Stresses in Structures.** Four credit hours. Four hours recitations weekly. Civil Engineering, third year, second semester Concurrent Mechanics 102.

**111. Summer Surveying Camp.** Civil Engineering at close of third year. Prerequisite, Civil Engineering 104, and 105.

Four weeks of six days per week of ten hours per day, from the middle of June to the middle of July.

**112. Railway Location.** Four credit hours. Four recitations per week. Optional with Civil Engineering 114. Civil Engineering, fourth year, second semester. Prerequisite, Civil Engineering 102 and 111, and Mechanics 102.

**113. Bridge Designing.** Four credit hours. Four recitations per week. Civil Engineering, fourth year, first semester. Prerequisite, Civil Engineering 110.

**114. Advanced Bridges.** Four credit hours. Four recitations per week. Optional with Civil Engineering 112. Civil Engineering, fourth year, second semester. Prerequisite, Civil Engineering 113.

**115. Masonry Construction.** Three credit hours. Three recitations weekly. Civil Engineering, fourth year, first semester. Prerequisite, Civil Engineering 111, Mechanics 102.

**116. Masonry Structures.** Three credit hours. Three recitations, lecture or drawing periods per week. Civil Engineering, fourth year second semester. Prerequisite, Civil Engineering 115.

**117. Water Supply.** Three credit hours. Three recitations per week. Civil Engineering, fourth year, first semester. Prerequisite, Civil Engineering 111, Mechanics 102.

**118. Cement and Concrete.** Three credit hours. Architecture, Ceramic, and Civil Engineering, fourth year, second semester. Prerequisite, Mechanics 102, or 104.

**119. Thesis.** One credit hour. Civil Engineering, fourth year, first semester. Prerequisite, Civil Engineering 110, and 111.

**120. Contracts and Specifications.** Two credit hours. Two recitations or lectures weekly. Civil Engineering, fourth year, second semester. Prerequisite, Civil Engineering 106, 109, and 115.

**121. Surveying and Topographic Drawing.** Six credit hours. First semester. Prerequisite, Mathematics 114 or 132, and Engineering Drawing 101.

The work will be divided into lectures, recitations, field work, computing, and drawing in such manner as the schedule and weather will permit.

**122. Thesis.** Four credit hours. Civil Engineering, fourth year second semester. Prerequisite, Civil Engineering 119.

**123. Trusses.** Lectures, recitations, and drawing. Three credit hours. Ceramic, and Mechanical Engineering, fourth year, first semester. Drawing the last three or four weeks. Prerequisite, Mechanics 102, or 104.

**124.** Repetition of 123. Architecture and Mine Engineering third year, second semester. Concurrent, Mechanics 102, or 104.

**125. Tall Buildings**. Three credit hours. Three lectures weekly. Architecture, fourth year, first semester. Prerequisite, Civil Engineering 124.

**126. Timber and Masonry**. Two credit hours. Two lectures or recitations weekly. Mechanical Engineering, third year, second semester. Concurrent Mechanics 102.

**128. Plane Surveying.** Two credit hours. Two lectures and one field exercise of three hours per week. Architecture, fourth year, second semester, and Mechanical Engineering, second year, second semester. Prerequisite, Engineering Drawing 102, Mathematics 132.

### DRAWING

(See Engineering Drawing)

## ELECTRICAL ENGINEERING

(Office, room 171, Robinson Laboratory)

PROFESSOR CALDWELL, PROFESSOR HUNT, ASSISTANT PROFESSOR MC OMBER, MR. SHEPARDSON, MR. HEITMANN.

### EQUIPMENT

This department is located in the north end of the Robinson Laboratory. (See page 39.) It has one large dynamo laboratory, 90x112 feet, and seventeen smaller rooms. There are also two long balconies used for drafting and computation.

Among the smaller rooms the following may be especially noted: The calibration room is well and conveniently fitted up with standards. These are kept accurate by frequent comparison at the National Bureau of Standards and are at the service of the electrical industries of the State.

Two telephone laboratories are separated by a sound-proof partition. They are well equipped with apparatus of different makes, including a set of Western Electric switchboard apparatus. There is also an artificial 100-mile line, comparison apparatus, and a 5-station 2-wire set loaned by the Automatic Electric Company, and used as an intercommunicating set for the departmental office. Wireless telegraphy has been introduced, and a wireless station installed.

The illumination laboratory is fitted for working with light or dark walls; there is a good photometric outfit and an illuminometer. The cable and iron testing laboratory is used for such work as requires galvanometers and other delicate apparatus. The battery room contains a 200-ampere-hour storage battery, with end-cell switching arrangements, etc. There are two small shops fitted up for the construction and repair of apparatus by the department machinist. The necessary recitation rooms, offices, etc., are provided, and a museum with a collection of material illustrating applied electricity.

On the main floor is a space screened off for high potential work, where a 250,000-volt 50-kilowatt transformer forms a part of the equipment. Provision has been made for apparatus suitable for running and testing in the laboratory a complete interurban car. The dynamo equipment of forty generators and motors, both alternating and direct current, aggregates over 400 horsepower capacity, and includes all important commercial types. A liberal equipment of measuring instruments of various kinds is available, including potentiometer, oscillograph, tachometers, frequency meters, etc.

## SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**101. Electrical Engineering.** Five credit hours. Three lectures and one four-hour laboratory period weekly. Chemical Engineering, and Mechanical Engineering, fourth year, first semester. Prerequisite, Physics 112, or Physics 114.

Lectures and laboratory work on direct and alternating current circuits, dynamo machinery, transformers, accumulators, and their applications.

**103. Electrical Engineering.** Three credit hours. Two lectures and one three-hour laboratory period weekly. Civil Engineering, third year, Mine Engineering, fourth year, first semester. Prerequisite, Physics 112, or 114.

Lectures and laboratory work on direct current machinery, circuits, and transmission.

**104. Direct Current Machinery.** Five credit hours. Three lectures and one four-hour laboratory period weekly. Electrical Engineering, third year, second semester. Prerequisites, Physics 135, and Mathematics 142.

Generators and motors, their theory, construction, and operation. Lectures, recitations, problems, and laboratory.

**106. Applications of Electricity.** Three hours for one-half semester. Three lectures per week. Electrical Engineering, third year, second semester. Prerequisites, Physics 135, and Mathematics 142.

A brief treatment of the uses of electricity, illumination, railways, mining, etc.

**108. Alternating Current Circuits and Machinery.** Three hours, for one-half semester. Electrical Engineering, third year, second half of second semester. Prerequisites, Mathematics 142, Physics 135, and Electrical Engineering 106.

General principles, circuits, generators, and transformers,

**109. Alternating Current Machinery.** A continuation of Electrical Engineering 108. Three credit hours. Three lectures weekly. Electrical Engineering, fourth year, first semester. Prerequisite, Electrical Engineering 108, and concurrent, Electrical Engineering 111.

Transformers, synchronous motors, induction motors, etc.

**111. Alternating Current Laboratory.** Three credit hours. Electrical Engineering, fourth year, first semester. Prerequisite, Electrical Engineering 108, Concurrent Electrical Engineering 109.

Alternating current, railway and telephone apparatus, accumulators.

**112. Advanced Alternating Current Laboratory.** Three credit hours. Electrical Engineering, fourth year, second semester. Prerequisite, Electrical Engineering 109 and 111.

**113. Electrical Railways.** Two credit hours. Electrical Engineering, fourth year, first semester. Alternative with Electrical Engineering 115, 117, 119. Prerequisite, Electrical Engineering 104, Concurrent Electrical Engineering 109. Systems, apparatus, and operation.

**115. Telephony.** Two credit hours. Electrical Engineering, fourth year, first semester. Alternative with Electrical Engineering 113, 117, and 119. Prerequisites, Electrical Engineering 104 and 108.

Methods of operation, simple circuits and apparatus, elements of transmission theory.

**117. Electric Illumination.** Two credit hours. Electrical Engineering, fourth year, first semester. Alternative with Electrical Engineering 113, 115, and 119. Prerequisites, Electrical Engineering 104 and 108.

Principles of illumination, electric lamps, wiring plans, etc.

**119. Wireless Telegraphy.** Two credit hours. Electrical

Engineering, fourth year, first semester. Alternative with Electrical Engineering 113, 115, 117. Prerequisites, Electrical Engineering 104 and 108.

Elementary theory, production, transmission, and detection of damped and undamped oscillations.

**121. Electrical Design.** Three credit hours. Two lectures and one four-hour drawing period weekly. Electrical Engineering, fourth year, first semester. Prerequisite, Electrical Engineering 104.

Direct current dynamos, transformers, etc.

**122. Electrical Design.** Two credit hours. A continuation of Electrical Engineering 121. One lecture and one three-hour drawing period weekly. Electrical Engineering, fourth year, second semester. Elective.

Alternating current apparatus.

**124. Electrical Transmission and Distribution**. Two credit hours. Two lectures weekly. Electrical Engineering, fourth year, second semester. Prerequisite, Electrical Engineering 109.

Systems, apparatus, and operation.

**125. Special Reading and Laboratory.** Credit hours to be arranged. Elective for fourth year Electrical Engineering and graduate students with consent of the instructor in charge. First semester. Prerequisites, Electrical Engineering, 104 and 108.

**126. Special Reading and Laboratory**. A continuation of Electrical Engineering 125. Second semester.

**127. Thesis**. One credit hour. Electrical Engineering, fourth year, first semester. Prerequisites, Electrical Engineering 104 and 108.

**128. Thesis**. Five credit hours. Electrical Engineering, fourth year, second semester.

**130. Inspection Trip to the East**. Given only in the even years. The seventh week before Commencement. Electrical Engineering, third or fourth year.

Includes Pittsburg, Buffalo, Niagara, and Cleveland. The entire expense need not exceed $32. A satisfactory written report is required.

**132. Inspection Trip West**. Given only in the odd years. The seventh week before Commencement. Electrical Engineering, third or fourth year.

Includes Chicago, Milwaukee, Fort Wayne, and Gary. The entire expense need not exceed $32. A satisfactory written report is required.

**134. Reading Course.** Electrical Engineering, third or fourth years. This may be taken as a substitute for Electrical Engineering 130 on presentation of reasons satisfactory to the head of the department.

Assigned reading on processes of manufacture and power plants

**136. Reading Course.** Electrical Engineering, third or fourth years. This may be taken as a substitute for Electrical Engineering 132 on presentation of reasons satisfactory to the head of the department.

## ENGINEERING DRAWING

(Office, Room 42, Brown Hall)

PROFESSOR FRENCH, ASSISTANT PROFESSOR MEIKLEJOHN, MR. WILLIAMS, MR. HARPER, MR. SHEETS, MR. IVES, MR. TURNBULL, MR. NORRIS

### EQUIPMENT

For Engineering Drawing there are four large, well lighted drawing rooms in Brown Hall and two in Hayes Hall, equipped with individual drawing tables and lockers, and two lecture rooms, with electric projection lantern. A blue print room is provided with electric light printing machine and sun frames. There is a good set of models illustrating intersections and warped surfaces, and a large collection of machine parts, small machines, patterns, core boxes and models, with a case of machinist's tools such as calipers, scales, surface gauges, etc. for use in machine sketching.

The department has an equipment of many special instruments for illustration and use, such as Universal drafting machines, Kelsey drafting rig, suspended pantograph, Ockerson machine, different types of section liners, lineads, curves, proportional dividers, protractors, special pens, etc.

Hand books, data sheets, catalogues and typical examples of shop drawings are available for student use.

The library contains an unusually extensive collection of books on descriptive geometry, machine design, graphics, perspective and lettering.

### SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**101. Elementary Mechanical Drawing.** Two credit hours. All four-year courses, first year, first semester.

Practice in the use of drawing instruments, elementary projections.

**102. Mechanical Drawing.** Three credit hours. All four-year courses, first year, second semester. Prerequisite, Drawing 101.

Lettering, orthographic, isometric, and oblique projections.

**103. Descriptive Geometry.** Three credit hours. Two recitations, one drawing period weekly. Ceramic, chemical, electrical, mechanical and mining engineering, second year, first semester. Prerequisite, Drawing 102, or 114.

**104. Machine Sketching.** Three credit hours. One lecture, two drawing periods weekly. Ceramic, chemical, mechanical and mine engineering, second year, second semester. Prerequisite, Drawing 103.

**105. Descriptive Geometry.** Three credit hours. Two lectures, one drawing period weekly. Civil Engineering, second year, first semester. Prerequisite, Drawing 102.

**106. Advanced Descriptive Geometry.** Three credit hours. Two lectures, one drawing period weekly. Civil Engineering, second year, second semester. Prerequisite, Drawing 105.

**107. Descriptive Geometry.** Three credit hours. Two recitations, one drawing period weekly. Architecture, second year, first semester. Prerequisite, Drawing 102.

**110. Technical Sketching.** Two credit hours. Electrical Engineering, second year, second semester. Prerequisite, Drawing 103.

**111. Technical Drawing.** Two credit hours. Mechanical and Electrical Engineering, third year, first semester. Prerequisite, Drawing 104, or 110.

**113. Free-hand Drawing and Lettering.** Four credit hours. Short courses in Clay Working and Industrial Arts, first year, first semester. Short mining course, second year, first semester.

**114. Mechanical Drawing.** Three credit hours. Short courses in Clay Working, Industrial Arts, first year, second semester. Short mining, second year, second semester. Prerequisite, Drawing 113.

**115 Charcoal from Architectural Ornament.** Two credit hours. Architecture, second year, first semester.

**116 Pen Drawing.** Two credit hours. Architecture, second year, second semester.

**117. Water Color.** Three credit hours. Architecture, third year, first semester.

**118. Charcoal Drawing from the Antique.** Three credit hours Architecture, third year, second semester. Prerequisite, Drawing 115.

**119. Clay Modeling.** Two credit hours. Architecture, fourth year, first semester. Prerequisite, Drawing 115.

**121. Technical Drawing.** Two credit hours. Designing of chemical plants and machinery. Chemical Engineering, third year first semester. Prerequisite, Drawing 104.

**122. Technical Drawing.** Two credit hours. Continuation of 121. Chemical Engineering, third year, second semester.

## ENGLISH

(Office, English Building)

PROFESSORS DENNEY, MCKNIGHT, ASSOCIATE PROFESSOR GRAVES, ASSISTANT PROFESSORS DUNCAN, COOPER, HARRINGTON, BECK.

**101. Paragraph Writing: Description and Narration.** Two credit hours. First semester. (Course 101 will be repeated in the second semester as course 102 for the benefit of those who fail, the class meeting Saturdays at 9 a.m.)

**104. Paragraph Writing: Exposition and Argumentation.** Two credit hours. Second semester. Prerequisite, course 101. Same hours as for course 101. (Course 104 is also offered in the Summer Session.)

## GEOLOGY

(Office, Room 1, Orton Hall)

PROFESSOR PROSSER, PROFESSOR BOWNOCKER, ASSISTANT PROFESSOR HILLS, MR. MORSE

### EQUIPMENT

This department is located in Orton Hall and is noted for its fine museum of geological material. As the collections of the State Geological Survey are permanently located here, the material illustrative of Ohio formations is particularly complete. It is interesting in this connection to know that in the construction of the building a great variety of material contributed from various quarries of Ohio was used. Thus the building itself forms an important part of the geological collections. Good opportunities are provided for the work in the lithological, stratigraphical, and physiographic laboratories.

## SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**162. Elementary Physiography.** Four credit hours. Short mining, first year, second semester.

The topographic features of the earth's surface and the agencies producing them. The atmosphere; the ocean; rivers. Recitations, lectures, map work, and field work.

**164. Elementary Geology.** Three credit hours. Short mining, second year, second semester.

Lithological, dynamical, structural, and historical geology. Recitations, lectures and laboratory work.

**165. General Geology.** Three credit hours. Mine Engineering, third year, first semester.

Structural, dynamical, and historical geology. The lectures are illustrated by maps, specimens, and lantern views. The common rock forming minerals and rocks are studied in the laboratory. The first half of the semester, field trips Friday afternoon or Saturday morning will alternate with laboratory periods.

**166. Petrography.** Two credit hours. Mine Engineering, third year, second semester.

A study of hand specimens of igneous, metamorphic, and sedimentary rocks, lectures and laboratory work.

**167. Economic Geology.** Three credit hours. Mine Engineering, fourth year, first semester. Prerequisite, Geology 165-166.

The nature and origin of ores; their modes of occurence and distribution. The non-metals, coal, oil, gas, clay, lime, cement, and building stones. In the discussion of the non-metals emphasis will be laid on the products of Ohio.

**168. General Geology.** Three credit hours. Ceramic Engineering, fourth year, Civil Engineering second year, second semester.

Structural, dynamical, and historical geology. The lectures are illustrated by maps, specimens, and lantern views. The common rock-forming minerals and rocks are studied in the laboratory. The last half of the semester, field trips Friday afternoon or Saturday morning will alternate with laboratory periods.

## GERMANIC LANGUAGES AND LITERATURES

(Office, Room 317, University Hall)

PROFESSOR EVANS, ASSOCIATE PROFESSOR EISENLOHR, ASSISTANT PROFESSORS THOMAS, AND BARROWS, MR. BUSEY.

**101-102. Elementary German.** Four credit hours. The year. Open to students in any four-year course who enter with a language other than German.

The essentials of grammar, the first semester.

Reading of easy narrative with grammatical drill, second semester.

**103. Intermediate German.** Four credit hours. Prerequisite, German 102, or two units entrance credit in German. Not open to students who enter with four units entrance credit in German.

Reading of narrative prose, with topical review of grammar. One hour Prose Composition weekly.

**106. Science Reading.** Four credit hours. Second semester.

This course is for Engineering Students; a continuation of Courses 103, 107 or 109

Rapid reading of German technical literature. Drill on sentence structure and word formation. The object of the course is to put students in the way of reading technical works and current technical literature.

**107. Recent Fiction and Prose Composition.** Four credit hours. Open to first year students who enter with four units credit in German.

**109. Historical Fiction and Prose Composition.** Four credit hours. Open to first-year students who enter with four units credit in German.

## INDUSTRIAL ARTS AND SHOPWORK

(Office, Room 2, Hayes Hall)

PROFESSOR SANBORN, ASSOCIATE PROFESSOR KNIGHT, MR. CROWE, MR. CASE, MR. BEEM, MR. DENMAN

### EQUIPMENT

The carpenter and pattern shops are fitted with well designed benches, and a complete set of carpenter tools is contained in the drawer and cupboard of each bench. There are also wood-turning lathes including an eight-foot pattern-maker's lathe. Among the power tools, planers of different kinds, and circular, scroll, and band saws may be mentioned. In the forge shop, besides the usual forges and anvils with the accompanying hand tools, there are a number of special tools. Among these are a special gas furnace, foot-power hammer, drill, and a combined punch, shear, and bar cutter. The foundry has a twenty-four-inch Colliau cupola; there are also brass furnaces and a core oven. In the machine shop, besides the benches and tools for vise work and a good equipment of lathes of various types, there may be mentioned a monitor turret lathe, planers, shapers, milling machines, grinding machines, and arbor presses. There is also a full equipment of small tools, including a great variety of special ones.

## SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**101. Tools and Machines.** Three credit hours. Three recitations weekly. Short Industrial Arts, second year, first semester. Prerequisite, Mathematics 114 or 132. Concurrent Physics 101.

Principles underlying the construction and operation of machines with a special study of machine tools.

**102.** Continuation of 101. Three credit hours. Three recitations weekly. Short Industrial Arts, second year, second semester.

**103. Designing.** Two credit hours. Two three-hour laboratory periods weekly. Short Industrial Arts, second year, first semester. Concurrent, Industrial Arts 101.

**104.** Continuation of 103. Two credit hours. Two three-hour laboratory periods weekly. Short Industrial Arts, second year, second semester. Concurrent, Industrial Arts 102.

**110. Strength of Materials.** Six credit hours. Five recitations and one three-hour laboratory period weekly. Short Industrial Arts, second year, second semester.

Study and strength of properties of materials and their use in machines.

**112. Machine Design.** Two credit hours. Two two-hour periods weekly. Electrical Engineering, fourth year, second semester. Prerequisite, Mechanics 102, and Engineering Drawing 111.

Practical application of principles of machine design.

**114. Shop Building.** Two credit hours. Two recitations weekly. Alternative with Mechanical Engineering 146, fourth year, second semester. Prerequisite, Civil Engineering 126.

Lectures and problems on the construction of shop building and the arrangement of machinery; special shop appliances.

## SHOPWORK

(The classes in shopwork are carried under a different set of numbers from the theoretical classes in Industrial Arts given above, though they are in the same department.)

**105. Foundry Work.** One and two-thirds credit hours. One recitation and one three-hour laboratory weekly. Mechanical Engineering, second year, first semester.

Exercises and practice on tempering sand and preparing molds of machine parts in sand, core-making, melting iron and brass, and pouring.

**106.** Repetition of 105. Short Industrial Arts, first year, second semester.

**107. Chipping and Filing.** One and one-third credit hours. Two two-hour laboratory periods weekly. Mechanical Engineering, second year, first semester. Ceramic Engineering, alternative with 109 and 115.

Exercises and practice in vise work including chipping in cast, and wrought iron, surface filing, squaring, fitting, finishing. and the scraping of surface plates.

**108.** Repetition of 107. Short Industrial Arts, first year, second semester.

**109. Joinery and Pattern-Making.** Two credit hours. One recitation and two two-hour laboratory periods weekly. Short Industrial Arts, first year, first semester. Ceramic Engineering, Short Clay-Working, alternative with Shopwork 107 and 115; Chemical Engineering, Electrical Engineering, Mechanical Engineering, and Mine Engineering during the Summer Session at the close of first year.

Exercises and practice in joinery, wood-turning, and pattern-making, including sawing, planing, mortising, framing, and other work involving the use of the ordinary carpenter tools, center and chuck turning, and the making of finished patterns.

**110.** Repetition of 109.

**111. Advanced Pattern-Making.** Two credit hours. One recitation and two two-hour laboratory periods weekly. Mechanical Engineering, second year, first semester. Prerequisite, Shopwork 109.

**112.** Repetition of 111. Short Industrial Arts, first year, second semester.

**113. Cabinet-Making.** Two credit hours. Two three-hour laboratory periods weekly. Elective, first semester. Prerequisite, Shopwork 109 or 110.

Exercises and practice in cabinet-making, including paneling, mitre and dove-tail joints; use of power tools.

**114.** Repetition of 113. Elective, second semester.

**115. Forging.** Two credit hours. One recitation and two two-hour laboratory periods weekly. Short Industrial Arts, second year, first semester. Ceramic, Chemical, Electrical, Mechanical, and Mine Engineering, and Short Clay-Working, during the Summer Session at the close of first year.

The use and care of forge, fire, and tools. Practice in iron and steel forging, including such operations as cutting, bending, drawing, upsetting, shaping and welding iron; the making, hardening and tempering of steel punches, chisels, and lathe tools.

**116.** Repetition of 115. Short Mining, first year, second semester.

**118. Advanced Forging.** Two credit hours. Two three-hour laboratory periods weekly. Elective, second semester. Prerequisite, Shopwork 115.

Various forms of welds in iron and steel; the use of scrolling irons and of forms for duplicating work; annealing; tool-making; case-hardening; tempering drills, dies and cutters; spring-making; ornamental iron work; visits to shops.

**119. Machine Work.** Three credit hours. One recitation and two three-hour laboratory periods weekly. Electrical Engineering and Short Industrial Arts, second year.

Elementary exercises on the engine lathe, such as plain, straight, and taper turning, screw cutting, chucking, boring, filing and polishing, and the use of the drill press.

**120.** Repetition of 119. Mechanical Engineering, second year, second semester.

**121. Advanced Machine Work.** Three credit hours. One recitation and two three-hour laboratory periods weekly. Mechanical Engineering, third year, first semester. Prerequisite, Shopwork 119 or 120.

A continuation of course 119 or 120 with more difficult exercises in the lathe, including square thread cutting, drilling, and tapping, use of steady rest, face-plate work and bar turning. Also practice on the milling machines, planer, shaper and turret lathe.

**122.** Repetition of 121. Electrical Engineering and Short Industrial Arts, second year, second semester.

**123. Advanced Machine Work.** Two credit hours. Two three-hour laboratory periods weekly. Elective, first semester. Prerequisite, Shopwork 121 or 122.

A more advanced course in milling machine work and grinding Exercises in spur and spiral gear cutting, cam cutting, and differential and fractional indexing.

**125. Construction Work.** Two credit hours. First semester. Two three-hours laboratory periods weekly. Elective. Prerequisite, Shopwork 121 or 122.

A course in construction work on any piece of apparatus or machinery which may be in course of construction in the shops.

**126.** Repetition of 125. Second semester. Elective.

**127. Tool-Making and Jig Work.** Three credit hours. First semester. Elective. Prerequisite, Shopwork 123.

**128.** Repetition of 127. Three credit hours. Elective, second semester.

## MATHEMATICS

(Office, Room 314, University Hall)

PROFESSOR BOHANNAN, PROFESSOR McCOARD, PROFESSOR SWARTZEL, PROFESSOR KUHN, ASSOCIATE PROFESSOR ARNOLD, ASSOCIATE PROFESSOR RASOR, ASSISTANT PROFESSORS PRESTON, BAREIS, MORRIS, WEST, MISS RICKARD, MR. WEAVER

**101. Elementary Algebra.** Five credit hours. Five recitations weekly. Short Clay-working, Short Industrial Arts, and Short Mining, first year, first semester. Text-book, Wentworth's Alegbra.

**102.** Continuation of 101. Five credit hours. Five recitations weekly. Short Clay-working, Short Industrial Arts, and Short Mining, first year, second semester. Prerequisite, Mathematics 101.

**113. Plane and Solid Geometry.** Five credit hours. Five recitations weekly. Short Clay-working, Short Industrial Arts, and Short Mining, first year, first semester. Text-book, Venable's Geometry.

**114. Solid Geometry and Plane Trigonometry.** Five credit hours. Five recitations weekly. Short Clay-working, Short Industrial Arts, and Short Mining, first year, second semester. Prerequisite, Mathematics 113. Text-books, Venable's Geometry, and Bohannan's Trigonometry.

**131. Trigonometry and College Algebra.** Five credit hours.

Five recitations weekly. All four-year courses in Engineering, first year, first semester. Prerequisites, Entrance Algebra and Geometry. Text-books, Bohannan's Trigonometry and Rietz and Crathorne's College Algebra.

This course is repeated in the second semester for the benefit of the students who fail in the first semester.

**132. Analytical Geometry and College Algebra.** Five credit hours. Five recitations weekly. All four-year courses in Engineering, first year, second semester. Prerequisite, Mathematics 131. Text-books, Fine and Thompson's Analytical Geometry, and Rietz and Crathorne's College Algebra.

This course is repeated in the Summer Session.

**141. Calculus.** Five credit hours. Five recitations weekly. All four-year courses in Engineering, second year, first semester. Prerequisite, Mathematics 132. Text-book, Osborne's Calculus.

This course is given in the second semester for the benefit of those who fail in the first semester.

**142.** Continuation of 141. Five credit hours. Five recitations weekly. All four-year courses in Engineering, second year, second semester. Prerequisite, Mathematics 141.

This course is given in the Summer Session.

**151. Differential Equations.** One credit hour. One recitation weekly. Mechanical Engineering, third year, first semester. Prerequisite, Mathematics 142. Text-book: Boyd's Differential Equations.

**169. Differential Equations.** Two credit hours. Two recitations weekly. Elective, first semester. Prerequisite, Mathematics 142. Text-book: Boyd's Differential Equations.

**Higher Mathematics.** Elective. See bulletin of the College of Arts, Philosophy, and Science for special courses. Differential Equations and Fourier's Series particularly recommended to Electrical Engineers.

## MECHANICAL ENGINEERING

(Office, Room 244, Engineering Laboratory)

PROFESSOR MAGRUDER, PROFESSOR HITCHCOCK, ASSOCIATE PROFESSOR JUDD, ASSISTANT PROFESSOR VALLANCE, MR. BAILEY.

### EQUIPMENT

The Department of Mechanical Engineering occupies the south end of the Robinson Laboratory. The main laboratory is 90 feet by 112 feet, and is divided into three sections. The steam-engineering section contains three 35-horsepower, horizontal, plain and automatic cut-off engines; one 60-horsepower tandem compound, horizontal, automatic cut-off engine; one 10-horsepower two cylinder single acting engine; one 30-horsepower tandem, compound, vertical engine, with riding cut-offs and link motions; one 250-horsepower, cross-compound, vertical engine, with reheater; one 60-horsepower simple Corliss engine; one 15-horsepower vertical engine, and one 3-horsepower square-piston engine. Most of the above are arranged to be worked as condensing engines if desired, and are provided with surface condensers, air and circulating pumps, etc. The hydraulic section is equipped with eleven cisterns, a flume having a cross-section of thirteen square feet, submerged orifices up to thirty inches in diameter, a 30-foot well, and weirs capable of measuring up to 16,000 gallons per minute. It is provided with simple, compound, triplex-centrifugal, and rotary pumps, pulsometer, turbine and impulse water-wheels, and a variety of apparatus specially adapted to study the flow of liquids. The third section contains Riehlé and Olsen testing machines for materials in tension, compression, bending shear, and torsion; dynamometers for measuring the power supplied to machines; and the departmental machine shop. Supported by the columns carrying the sawtooth roof, and between the sections, are two galleries, each 8 feet by 108 feet. One of them is used as a drawing room; the other is used to study the flow of steam, air and water through pipes and bends.

Next to the steam laboratory is a section, 48 feet by 144 feet, adapted for the operation and testing of steam boilers and gaspower machinery. The boiler laboratory is equipped with a horizontal, internally-fired, tubular boiler, a horizontal return-flue boiler, exterior fired with brick setting, a locomotive boiler, and a 107-horsepower Babcock and Wilcox watertube boiler, provided with both an automatic stoker and a Dutch-oven furnace having shaking grates with forced, induced, and chimney drafts, and a complete equipment of testing appliances. The gas engine laboratory has three oil engines and three gas engines of 6 and 10 horsepower, one 10-horsepower, two-cylinder, two-cycle motor-boat gasoline engine fitted with propellors working in a tank; one 25-horsepower, two-cycle, and one 80-horsepower, two-cylinder, tandem, four-cycle, horizontal engine, each operated with either natural gas or producer gas; one 75-horsepower suction gas producer for use with either anthracite gas or bituminous coals, with complete facilities for measuring the fuels, air, and water which are used and the power developed.

Between the boiler room and the electrical engineering laboratory is the demonstration amphitheater and lecture room. In the rear of the amphitheater is a spacious laboratory which is intended for the testing of automobiles, but is as yet only partially equipped.

The two-story portion at the south end of the building is used for offices, three class rooms, an engineering museum, locker rooms, oil-testing laboratory, photographic dark-room, and instrument room.

## SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**101. Mechanism.** Three credit hours. Three recitations weekly. Electrical Engineering, third year, first semester. Prerequisites, Engineering Drawing 103, and Physics 114.

Recitations on the principles of mechanism and mechanical movements.

**103. Steam Power Plants.** Three credit hours. Three recitations weekly. Chemical, Electrical, and Mechanical Engineering, third year, first semester. Prerequisites, Engineering Drawing 104 and Physics 112.

A descriptive study of steam-generating and steam using machinery.

**110. Mechanism and Machine Design.** Three credit hours. Three recitations weekly. Ceramic Engineering, third year, second semester. Prerequisite, Drawing 104, Physics 112, and Mechanics 101.

Recitations on the principles of mechanism, mechanical movements, and elementary machine design.

**114. Mechanism.** Three credit hours. Three recitations weekly. Mechanical Engineering, third year, second semester. Prerequisite. Drawing 104, and Physics 112.

Recitations and practice on the principles of mechanism and mechanical movements.

**116. Mechanism Drawing.** One credit hour. One three-hour drawing period weekly. Mechanical Engineering, third year, second semester. Prerequisite or concurrent, Mechanical Engineering 114.

Practice in laying out mechanisms and mechanical movements.

**118. Steam Engines and Boilers.** Four credit hours. Four recitations weekly. Electrical and Mechanical Engineering, third year, second semester. Prerequisites, Mechanical Engineering 103 and Mechanics 101.

**121. Heating and Ventilating.** Two credit hours. Two recitations weekly. Architecture, fourth year, first semester. Prerequisite Mechanics 101.

Recitations and lectures on the principles and methods of heating and ventilation, with laboratory work and investigations of the heating and ventilating plants of different buildings.

**123. Materials of Construction.** Two credit hours. One recitation and one three-hour laboratory period weekly. Required in Architecture, fourth year, first semester. Prerequisite Mechanics 101.

Lectures and recitations on the materials used in architectural and building construction, and laboratory exercises on their properties.

**125. Gas Engines and Producers.** Two credit hours. Two recitations weekly. Required in Mechanical Engineering, fourth year, first semester. Prerequisite, Mechanical Engineering 118.

A study of gas-engines and of gas-producers as used for power purposes.

**127. Machine Design.** Five credit hours. Five recitations weekly. Required in Chemical and Mechanical Engineering, fourth year, first semester. Prerequisites, Drawing 104 and 111, Mechanics 102, and Metallurgy 109.

A detailed course of study based upon mechanics and the materials of construction applied to the design and construction of machinery.

**129. Thermodynamics.** Two credit hours. Two recitations weekly. Required in Mechanical Engineering, fourth year, first semester. Prerequisite, Mechanical Engineering 118.

The transmutations of heat and mechanical energies in steam and air engines, in air and ammonia compressors, and in refrigeration machines, together with a study of the tests of ideal and actual engines, and of their indicator diagrams; the flow of gases through pipes and orifices.

**130. Inspection Trip to the East.** The seventh week before Commencement Week, third or fourth years. Required in Mechanical Engineering. Prerequisite, Mechanical Engineering 103.

Given only in the even years.

Includes Pittsburg, Buffalo, Niagara Falls, Cleveland, and possibly other places. The entire expense need not exceed $32. A satisfactory written report upon the work of the trip is required.

**132. Inspection Trip to the West.** The seventh week before Commencement Week, third or fourth years. Required in Mechanical Engineering. Prerequisite, Mechanical Engineering 103.

Given only in the odd years.

Includes Chicago, Milwaukee, Gary, and possibly other places.

The entire cost need not exceed $32. A satisfactory written report upon the work of the trip is required.

**134. Written Report.** Course of assigned reading upon processes of manufacture and power plants taken and reported upon by the third and fourth year students in Mechanical Engineering as a substitute for Mechanical Engineering 130 on presentation of reasons satisfactory to the head of the department. The seventh week before Commencement Week, third or fourth years. Required in Mechanical Engineering.

**136. Written Report.** Similar to Mechanical Engineering 134, as a substitute for Mechanical Engineering 132. The seventh week before Commencement Week, third or fourth years. Required in Mechanical Engineering.

**140. Mechanism and Machine Design.** Two credit hours. Two recitations weekly. Required in Civil Engineering, fourth year, second semester. Prerequisite, Mechanics 102.

An elementary course in the principles of mechanism and mechanical movements and the design of parts of machines.

**142. Hydraulic Machinery.** Two credit hours. Two recitations weekly. Required in Mechanical Engineering, fourth year, second semester. Prerequisite, Mechanics 102, and Mechanical Engineering 118.

A study of pumping machinery.

**144. Machine Design.** Five credit hours. Three recitations and two three-hour drawing periods weekly. Required in Chemical and Mechanical Engineering, fourth year, second semester. Prerequisite, Mechanical Engineering 127.

A continuation of course 127, with practical applications on the drawing board of the principles to the design of some particular machine.

**146. Steam Turbines.** Two credit hours. Two recitations weekly. Optional in Mechanical Engineering with Industrial Arts 114, fourth year, second semester. Prerequisite, Mechanical Engineering 129.

A study of the generation of power by steam turbines, including auxiliary machinery.

**148. Thesis Work.** Three credit hours. Required in Mechanical Engineering, fourth year, second semester. Prerequisite, Mechanical Engineering 125, 127 or 129.

A special investigation or design based upon the work of the courses

**160. Experimental Engineering Laboratory.** Two credit hours.

One four-hour laboratory period weekly. Required in Electrical Engineering, third year, second semester. Concurrent, Mechanics 102, and Mechanical Engineering 118.

Calibration of pressure gauges and indicator springs, steam engine indicator practice, testing of lubricating oils, and the materials of construction.

**164. Experimental Engineering Laboratory.** Two credit hours. One four-hour laboratory period weekly. Required in Mechanical Engineering, third year, second semester. Concurrent, Mechanics 102, and Mechanical Engineering 118.

Calibration of pressure gauges and indicator springs; steam engine indicator practice; testing of oils and the material of construction.

**171. Experimental Engineering Laboratory.** Four credit hours. Two recitations weekly and one four-hour laboratory period weekly. Required in Ceramic Engineering, fourth year, first semester. Prerequisites, Mechanics 102, and Metallurgy 109.

Lectures and recitations on power transmissions, steam and gas engines, and boilers. Laboratory work in the calibration of pressure gauges and indicator springs; valve setting; testing of steam and gas engines; testing of steam and centrifugal pumps; boiler and fuel trials.

**173. Experimental Engineering Laboratory.** Five credit hours. One recitation weekly and two four-hour laboratory periods weekly. Required in Civil Engineering, fourth year, first semester. Prerequisite, Mechanics 102.

Practice in the testing of the materials of construction; calibration of orifices and weirs; study of the flow of liquids and gases; tests of steam, power, rotary, and centrifugal pumps; tests of water motors and turbine water wheels. Lectures and recitations on same and on steam engines, boilers, and transmission machinery.

**175. Experimental Engineering Laboratory.** Three credit hours. One six-hour laboratory period weekly. Required in Electrical Engineering, fourth year, first semester. Prerequisite, Mechanical Engineering 118 and 160.

Tests of steam engines and boilers; gas and oil engines; steam and power pumps; hydraulic experimentation; and the use of transmission and absorption dynamometers.

**179. Experimental Engineering Laboratory.** Two credit hours. One four-hour laboratory period weekly. Required in Mechanical Engineering, fourth year, first semester. Prerequisite, Mechanical Engineering 164. Concurrent, Mechanical Engineering 125 and 129.

Valve setting, moisture determinations in steam, gas calorimetry, measurements of flow of water by means of orifices, nozzles, weirs, and venturi-meter; tests of belts with use of transmission and absorption dynamometers.

**190. Experimental Engineering Laboratory.** Six credit hours. Four three-hour laboratory periods weekly. Required in Mechanical Engineering fourth year, second semester. Prerequisites, Mechanical Engineering 125, 129, and 179.

Tests of steam and hot air engines; steam boilers; gas and oil engines; gas producers; air compressors; injectors and pulsometers; centrifugal-rotary, and power pumps; hydraulic rams, impulse and turbine water wheels; fans and blowers and steams turbines.

**192. Experimental Engineering Laboratory.** Three credit hours. One recitation weekly and one four-hour laboratory period weekly. Required in Mine Engineering, fourth year, second semester. Prerequisites, Mechanics 102, and Metallurgy 109.

Lectures and recitations on power transmission, steam and gas engines, steam boilers, and gas producers. Laboratory work in the calibration of pressure gauges and indicator springs; valve setting; testing of steam engines; testing of steam and centrifugal pumps; boiler and fuel trials; tests of gas engines and gas producers.

## MECHANICS

(Office, Room 233, Mines Building)

PROFESSOR J. E. BOYD, ASSOCIATE PROFESSOR CODDINGTON,
MR. GRIFFIN

### EQUIPMENT

The Department of Mechanics occupies rooms in the Mines Building. The equipment consists of apparatus for a limited number of class room experiments designed to illustrate the fundamental facts of the science. It includes pulleys, platform scales, spring balances, a three-foot graduated circle for resolution of forces, apparatus for demonstrating couples in parallel planes, a chain for catenary experiments, model for shear and moment in beams, and apparatus for measuring acceleration and accelerating force.

The Department has a set of special extensometers for determining the maximum stress in bridge columns, and a second set for photographically recording the stresses due to moving trains. These are used jointly with the Department of Civil Engineering in thesis investigations.

The laboratory work in strength of materials, involving the use of testing machines, is given at present in the Department of Mechanical Engineering.

### SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**101. Statics and Strength of Materials.** Five credit hours. Architecture, Ceramic, Chemical, Civil, Electrical, Mechanical and Mine Engineering, third year, first semester. Prerequisite, Mathematics 142.

**102. Strength of Materials,** Continued. Kinetics and Hydraulics Five credit hours. Chemical, Civil, Electrical, Mechanical and Mine Engineering, third year, second semester. Prerequisite, Mechanics 101.

**104. Strength of Materials.** Two credit hours. Architecture and Ceramic Engineering, third year, second semester. Prerequisite, Mechanics 101.

## METALLURGY AND MINERALOGY

(Office, Room 100, School of Mines Building)

PROFESSOR SOMERMEIER, ASSISTANT
PROFESSOR DEMOREST

### EQUIPMENT

The equipment of this department is unusually complete. It occupies about 14,000 square feet of floor space at the east end of the basement and first floor of the School of Mines. In addition to the lecture rooms, there are separate laboratories for the following lines of work: For the analysis and assaying of iron, steel, ores, and furnace products by wet methods; for fire assaying and testing of gold and silver ores, equipped with furnaces and cyanide plant; for general and determinative mineralogy, equipped for blowpipe analysis and for the microscopic examination of minerals; for the calorimetric examination of coals and other fuels, technical gas analysis and the examination of mine air; for the microscopic examination and thermal tests of metals; and for the analysis and complete examination of coals. There is also a crushing and sampling plant for experimental tests on ores and minerals. The department now has a complete model New Century coal jig, a small experimental ore jig, and other apparatus for the practical testing of coal and ores by washing methods. The museum contains a large number of specimens and is being rapidly developed.

## SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**102. Mineral Chemistry.** Four credit hours. Short Mining second year, second semester. Prerequisite, Chemistry 101.

A course of lectures upon mine gases, safety lamps, mine explosions, boiler water, mine water, water supply, explosives, coal and coke.

**104. Crystallography and Mineralogy.** Two credit hours. Mine Engineering, second year, and Chemical Engineering, third year› second semester. Prerequisite, Chemistry 106. Two lecture hours.

Lectures on Crystallography and Physical Mineralogy. Illustrated by drawings and models.

**105. Fire Assaying.** Three credit hours. Mine Engineering, third year, first semester. Laboratory, two afternoons per week. Monday and Tuesday, or Thursday and Friday. Prerequisite, Metallurgy 106, or equivalent.

Lectures and laboratory work. Practical work in the assaying of gold, silver, and lead ores.

**106. Metallurgical Analysis.** Four credit hours. 1 lecture, 9 hours laboratory weekly. Mine Engineering, second year, second semester. Prerequisite, Chemistry 106 or 110, and Chemistry 119.

Lectures and laboratory work. Laboratory work in the analysis of iron ores, iron and steel, fuel and slags, and ores of lead, zinc, and copper by wet methods, using approved methods as practiced in technical laboratories and metallurgical works.

**107. Alloy Analysis.** Four credit hours. 1 lecture, 9 hours laboratory weekly. Mine Engineering, third year, first semester. Prerequisite, Metallurgy 106.

Lectures and laboratory work. Laboratory work in the analysis of alloy steels, such as vanadium, tungsten, chromium, nickel and molybdenum steels, and other alloys. Quantitative work preceded by qualitative tests on the alloys.

**108. Determinatve Mineralogy.** Three credit hours. 1 lecture ₇wo three-hour laboratory periods weekly. Mine engineering, third-year, second semester. Prerequisite, Metallurgy 104.

Lectures and laboratory work in practical determination of minerals by physical and chemical tests. Each student is furnished with a set of apparatus and works under an instructor's inspection. Brush and Penfield's Determinative Mineralogy is used as a manual.

**109. General Metallurgy.** Four credit hours. Mine Engineering, Mechanical Engineering, Chemical Engineering, third year, first semester; Ceramic Engineering, fourth year, first semester. Prerequisites, Chemistry 106, and Physics 114. Three lectures, one section; and two recitations in two sections.

Lectures and recitations on general metallurgy, fuels, iron and steel, their properties and manufacture.

**110. Metallurgy of Non-Ferrous Metals.** Four credit hours. Mine Engineering, third year, second semester. Three lectures, two recitations.

Lectures and recitations on the metallurgy of the non-ferrou metals; copper, lead, gold, silver, etc. The properties, reduction, and purification.

**111. Metallurgical Construction** Two credit hours. Mine Engineering, fourth year, first semester. Prerequisites, Drawing 111, Mechanics 102, Metallurgy 109 and 113.

Lectures and drawing room practice on the designing of furnaces and metallurgical plants.

**112. Technical Gas Analysis.** Two credit hours. Mine Engineering, third year, second semester. Two afternoons per week. Prerequisites, Metallurgy 106, 109, or equivalent.

Laboratory work supplemented by lectures. Technical analysis of metallurgical and mine gases. Determination of the calorific value of gases; problems involving application of results of gas analysis to furnace operation, mine ventilation, etc.

**113. Ore Dressing and Coal Washing.** Two credit hours. Mine Engineering, fourth year, first semester. Prerequisite, Metallurgy 109.

Methods of concentrating and enriching ores and fuels by mechanical means. Lectures with references to standard books and various papers in technical journals.

**114. Special Metallurgy.** Three credit hours. Mine Engineering fourth year, second semester. Hours to be arranged. Prerequisites. Metallurgy 106, 107, 109, 110, or equivalent.

Lectures and laboratory, supplemented by lectures on mine gases and water, safety appliances, explosives, microscopic examination of metals, study of properties of alloys, testing of metallurgical processes, pyrometry, and high temperature measurements, calorimetry, and other tests on fuels.

**116. Thesis.** Three credit hours.

# MILITARY SCIENCE AND TACTICS

(Office, The Armory)

CAPTAIN GEORGE L. CONVERSE, U. S. A., RETIRED

In accordance with the Morrill Act, passed in 1862, under which the University was established, military instruction must be included in the curriculum. The Board of Trustees therefore requires all male students, unless excused by the Military and Gymnasium Board, to drill during two years. This work is under an officer of the regular army, detailed for the purpose. The Military Department is open during five days each week throughout the year.

## EQUIPMENT

The equipment of the Military Department comprises 1000 standard U. S. Magazine rifles, with belts, bayonets and accoutrements, 21 regulation infantry officers' sabres and belts, 25 cadet swords and belts, a stand of regimental colors, with markers, guidons, etc. The target practice equipment comprises 6 Springfleld gallery rifles and 7 Winder-Model Winchester gallery rifles, 5 targets for 100, 200 and 300 yards, and 5 Winder-Model targets for long range. The band comprises about 60 pieces, partly supplied by the University and partly owned by the members.

The office is equipped for recording the attendance and performance of each cadet in drill, target practice and class-room work.

## ORGANIZATION

Cadet regiment is organized into three battalions of four companies each, a band, and trumpet corps. Each battalion has its own staff officers. The total number of men under arms averages about one thousand at present. Service in the band is credited as military service. The appointment of cadet officers during the second year of service, is for excellence in their work. These officers may continue to serve during the third and fourth years if they wish, and if they do, are given compensation at the end of each year's satisfactory service, amounting to not less than twenty ($20.00) dollars for lieutenants and captains, and larger sums for officers of higher ranks. Members of the band who volunteer for service after having completed their two years required duty, are also paid at the rate of $20.00 per year, and receive instruction during the four winter months by a competent band-master.

## SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**1. Military Drill.** One credit hour. Five months, three hours per week (divided between fall and spring) military drill; four months, three hours per week, (winter) of class-room instruction in drill regulations. Target practice at any open hour during the afternoons of the winter months, at 100, 200 and 300 yards. Lecture, one hour weekly, by the President, upon topics of common interest to the student body.

**2. Military Drill.** One credit hour. Five months, three hours per week, (divided between fall and spring), in extended order and guard duty. Four months, three hours per week (winter) of class-room instuction in Articles of War, guard manual and field service regulations. Target practice, at any open hour of the afternoons of the winter months, at 500, 600 and 800 yards.

# MINE ENGINEERING

(Office, Room 200, Mines Building)

PROFESSOR RAY, ASSISTANT PROFESSOR MINOR.

## EQUIPMENT

The department occupies the east end of the second floor of the School of Mines Building and one basement room, and has a floor space of 6000 square feet. This includes the office of the department, a large lecture room, a drawing room with accommodations for fifty students, a blue-print room with full equipment for both sun and electric light printing, a laboratory for safety lamp testing and other special work, and in the basement a large room for work in ventilation.

The equipment includes all of the latest improved instruments and apparatus used in mine surveying and mine ventilation. There are a variety of surveying instruments for general practice, also targets, plummet lamps, etc., for mine and tunnel work. The laboratory contains apparatus for the testing and an outfit for the repair of safety lamps; and practice tests are made with the lamps for the detection and estimation of fire damp. An outfit for special analytical, chemical and mineralogical work is also available for use at all times. A growing collection of models of mines, coal tipples, metal head frames, split construction and the various types of framing are used in connection with the lectures and are kept in the museum for the use of the students. For the practical study of ventilation the equipment is complete, and includes anemometers, water gauges, barometers, barographs, polymeters, registers, etc., most of which are self-recording; there are also a portable gas apparatus, and various forms of rescue apparatus.

## SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**101. Mine Engineering.** Five credit hours. Lectures and field practice. Short Course in Mining, second year, first semester. Prerequisite, Mathematics 114. This course is similar to course 103, but more elementary. The same text is used. The students have more practice in the drawing room.

**102. Mine Engineering.** Five credit hours. Short Course in Mining, second year, second semester. Prerequisite, Mine Engineering 101 and Physics 101. Lectures illustrated by experiments, and maps of mines and models when possible; tests by safety lamps and anemometers; methods of air distribution in coal mines.

**103. Mine Engineering.** Mine Surveying. Five credit hours. Mine Engineering, second year, first semester, and Ceramic Engineering, third year, first semester. Prerequisites, Engineering Drawing 104, and Mathematics 132. Field practice in the use of instruments for surface and underground surveys. Field notes are taken and maps and plans made in the drawing room.

**104. Mine Engineering.** Plans and Specifications. Four credit hours. Mine Engineering, fourth year, second semester. Prerequisite, Mine Engineering 105, and Metallurgy 111. Practice in designing mine plants, drafting and estimating.

**105. Mine Engineering.** Five credit hours. Mine Engineering, fourth year, first semester. Prerequisites, Mechanics 102, Mine Engineering 103 and Geology 165. Lectures on mine operating, mining machinery, ventilation, shaft sinking, working out deposits, etc. Constant reference is required to standard works and to the leading technical journals.

**106. Mine Engineering.** Five credit hours. Mine Engineering, fourth year, second semester. Prerequisite, Mine Engineering 105. A continuation of Mine Engineering 105.

**107. Mine Engineering.** Two credit hours. Two two-hour drawing periods weekly. Short Mining, second year, first semester. Mine Engineering 101, concurrent.

**116. Thesis.** Three credit hours.

# PHYSICAL EDUCATION FOR MEN

(The Gymnasium)

PROFESSOR WINGERT, MR. BAUER

## EQUIPMENT

The University recognizes the need for the physical as well as the mental development of the students and provides the necessary means in a finely equipped gymnasium, the main floor of which is 80 by 150 feet. There is also a smaller gymnasium room, locker room, shower baths, and swimming pool. This work is done under a Director, who is a graduate physician and a member of the Faculty.

## SUBJECTS IN WHICH INSTRUCTION IS OFFERED

1. **Physical Education.** One credit hour. Two hours per week for one year. (a) Lectures on hygiene and physiology of exercise, first two weeks, first semester. (b) Corrective: A graded course of free hand exercise, stretching, relaxing, stimulating, exercise with light hand apparatus for the relief and correction of slight body defects, deformities, improper carriage, etc. (c) Educative: Graded progressive exercise on the apparatus and mats to promote muscular tone, vigor, vitality, endurance. (d) Recreative: Gymnasium games, mental relaxation, non-competitive exercises. (e) Ability to swim is required and free instruction is given to those who cannot swim.

2. **Advanced Exercises.** Elective. (a) Advanced exercises on the apparatus and mats. (b) Combatative exercises—boxing, fencing, wrestling. A small charge is made to those electing this work (c) Recreative: Football, baseball, basketball, tennis, track and field sport, cross-country running, etc. Special hours are arranged for those electing the above exercise and credit given in regular course.

# PHYSICS

(Office, Room 24, Physics Building)

PROFESSOR COLE, PROFESSOR THOMAS, ASSOCIATE PROFESSOR EARHART, ASSISTANT PROFESSOR SMITH, ASSISTANT PROFESSOR SHEARD, MR. HEIL, MR. NUSBAUM, MR. POTE AND MR. WEIMER

## EQUIPMENT

This science, upon the principles of which so much of the work of all classes of engineers is based, is well housed in the Physics Building. A lecture room, capable of seating 250 students, and with fine equipment, is used for the lectures of the second year. This course also includes recitations and laboratory work. The equipment for the latter permits each student to perform experiments illustrating the work covered in class. For the special laboratory work in mechanics and heat the equipment is good, including apparatus for showing the composition of forces, acceleration of gravity, balances, chronometers, chronographs, cathetometers, calorimeters,and various other forms of heat apparatus. In electricity and magnetism, upon which the work of the electrical engineering course so largely depends, the equipment is unusually complete, including, besides the necessary galvanometers, resistance boxes, voltmeters, ammeters, wattmeters, etc., many special instruments such as oscillographs, potentiometers, photometric apparatus and watt-hour meters. The laboratories for this work are located in the basement and are liberally provided with slate-capped brick piers and wall brackets which give excellent conditions for the use of galvanometers. The laboratories are thoroughly wired, and a large storage battery as well as a motor generator set and mercury vapor converter furnish current.

## SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**101. Elementary Physics.** Six credit hours. Five recitations and lectures, one three-hour laboratory period weekly. Short Clayworking second year, first semester. Short Mining, first year, first semester, Text-book, Millikin and Gale's Elements of Physics.

**111. General Physics.** Three credit hours. Two lectures, one recitation, and one two-hour laboratory period weekly. Architecture, Chemical, Civil, and Mine Engineering, second year, first semester. Prerequisites, Preparatory Physics and Mathematics 132.

**112.** Continuation of Physics 111. Three credit hours. Two lectures, one quiz, and one two-hour laboratory period weekly. Chemical, Civil, Mine, and Mechanical Engineering. Prerequisite, Physics 111.

**113. General Physics.** Mechanics and Heat. Five credit hours. Two lectures, three recitations, and one two-hour laboratory period weekly. Ceramic, Electrical, and Mechanical Engineering, second year, first semester. Prerequisites, preparatory Physics and Mathematics 132.

**114. General Physics.** Electricity, Light and Sound. A continuation of Physics 113. Five credit hours. Two lectures, three recitations, and one two-hour laboratory period weekly. Ceramic and Electrical, second year, second semester. Prerequisite, Physics 113.

**133. Physical Laboratory.** Two credit hours. Two two-hour laboratory periods weekly. Electrical Engineering, second year, first semester. Concurrent Physics 113.

**134. Physical Laboratory.** Three credit hours. Two three-hour laboratory periods weekly. Electrical Engineering, second year, second semester. Concurrent Physics 114.

**135. Physical Laboratory.** Five credit hours. Three three-hour laboratory periods weekly. Electrical Engineering, third year, first semester. Prerequisites, Physics 114 and 134.

Theory and practice of magnetic and electrical measurement, including the testing and standardizing of instruments; conductivity of conductors; insulation, capacity and resistance of insulated conductors and cables; temperature co-efficients; commercial measuring and testing instruments; strength and distribution of magnetic fields; magnetic moments; permeability; photometry of gas, electric, and other lights.

**137. Physical Laboratory.** Three to five credit hours. Prerequisite or Concurrent Physics 111.

**138. Physical Laboratory.** Two credit hours. Two two-hour laboratory periods weekly. Mechanical Engineering, second year, second semester. Prerequisite, Physics 111; Concurrent 112. Elective, three to five credit hours. Prerequisite 111, Concurrent 112.

**139. Physical Laboratory.** Three to five credit hours. A second year's work in Physical Laboratory. Elective, first semester. Prerequisite, Physics 138, or equivalent.

**140. Physical Laboratory.** Three to five credit hours. A continuation of Physics 139. Elective, second semester.

## ROMANCE LANGUAGES AND LITERATURES

(Office, Room 305, University Hall)

PROFESSOR BOWEN, PROFESSOR BRUCE, ASSOCIATE PROFESSOR INGRAHAM, ASSISTANT PROFESSOR HAMILTON, MR. CHAPIN

### FRENCH

**101-102. Elementary French.** Four credit hours. The year. Four recitations weekly, first year. May be taken by students in any four-year course who enter with no entrance credits in French. Textbooks: Thieme and Effinger's Grammar, or equivalent, and Aldrich and Foster's or Bowen's First Scientific Reader.

**103. Modern French Literature.** Four credit hours. Four recitations weekly, first year, first semester. May be taken by first year students in any four-year course who enter with two units entrance credits in French. Prerequisite, French 101-102, or two units entrance credits.

Nineteenth Century Prose, including (1) Contes, (2) the novel (Balzac or Hugo). Prose Composition. Systematic attention given to syntax and idiom.

**106 Science Reading.** Four credit hours. Four recitations weekly, first year, second semester. Must be taken by students in Engineering who take French 103 during the first semester.

## SPANISH

**101-102. Elementary Spanish.** Four credit hours. The year. Four recitations weekly, first year. May be taken by students in any four-year course who enter with no entrance credits in Spanish. Grammar, Hills & Ford's, and Ingraham's Victoria y Otros Cuentos. Easy Prose and Plays. Composition and Practice in speaking.

**103-104. Modern Spanish Literature.** Four credit hours. The year. Four recitations weekly. May be taken by students who enter with two units entrance credits in Spanish. Prerequisite, Spanish 101-102, or two units entrance credits.

The Novel and Drama of the nineteenth century. Composition and practice in speaking continued.

## SHOPWORK

(See Industrial Arts)

## SPANISH

(See Romance Languages)

# ENROLLMENT

November 1, 1910

| | |
|---|---|
| Students in Four-Year Courses Leading to Degrees............ | 792 |
| Students in Short Courses not Leading to Degrees............ | 35 |
| Special Students........ ................................ | 14 |
| Total.......... ................................ | 841 |

## Classification by Courses

| Name of Course Pursued | 4th year | 3d year | 2d year | 1st year | Unclassified | Total |
|---|---|---|---|---|---|---|
| First Year (Four-Year Courses)....... | .... | .... | ... | 252 | .... | 252 |
| Architecture ... .................... | 7 | 11 | 15 | .... | .... | 33 |
| Ceramic Engineering................. | 16 | 14 | 21 | .... | .... | 51 |
| Chemical Engineering................ | 12 | 18 | 21 | .... | ... | 51 |
| Civil Engineering .................... | 22 | 41 | 59 | .... | ... | 122 |
| Electrical Engineering................ | 44 | 44 | 47 | .... | .... | 135 |
| Mechanical Engineering.............. | 27 | 25 | 41 | ... | .... | 93 |
| Mine Engineering.................... | 15 | 18 | 20 | .... | .... | 53 |
| Special ............................ | .... | .... | .... | .... | 14 | 14 |
| Clayworking (Short)................ | .... | .... | 4 | 4 | .... | 8 |
| Industrial Arts (Short).............. | .... | .... | 6 | 12 | .... | 18 |
| Mining (Short)...................... | .... | .... | 4 | 5 | .... | 9 |
| Graduate........................... | .... | .... | .... | .... | 2 | 2 |
| Total.......................... | 143 | 171 | 238 | 273 | 16 | 841 |

# GRADUATES

November 1st, 1910.

**Classification by Courses**

| NAME OF COURSES | DEGREE CONFERRED | | NUMBER OF GRADUATES |
|---|---|---|---|
| Architecture | C. E. (in Arch.) | | 14 |
| Ceramic Engineering | E. M. (in Cer.)<br>Cr. E. | 13<br>44 | 57 |
| Chemical Engineering | B. Sc. (in Chem.)<br>B. Sc. (in Chem. Eng.) | 41<br>6 | 47 |
| Civil Engineering | C. E. | | 279 |
| Electrical Engineering | M. E. in E. E. | | 270 |
| Industrial Arts | B. Sc. (I. A.) | | 6 |
| Mechanical Engineering | M. E. | | 205 |
| Mine Engineering | E. M. | | 130 |
| Advanced Degrees | M. Sc. | | 2 |
| Total | | | 1010 |
| Less names counted twice | | | 6 |
| Net Total | | | 1004 |

# GENERAL INFORMATION

## SCHOLARSHIP

The Stillman W. Robinson Scholarship in Engineering, endowed for the encouragement of graduate research in engineering, provides five hundred ($500.00) dollars annually, and is open to graduates in Mechanical, Civil, and Electrical Engineering. Any student to whom this scholarship is awarded must devote his entire time to the work, which shall amount to at least sixteen hours per week, of which at least eight shall be in the line of original research or investigation. For one year's work and a satisfactory thesis, a master's degree may be given. For two year's work, and a satisfactory thesis, a doctor's degree may be given. For further information consult or address the Secretary of the College of Engineering.

## FEES

All fees must be paid at the opening of each semester as a condition of admission to classes.

**Tuition**—Tuition is free in this College, but registration is not complete until certain incidental and laboratory fees are paid.

**Incidental Fee**—The fee for students who are residents of Ohio is ten dollars a semester. For non-residents, the fee is fifteen dollars a semester. Children of non-resident Alumni pay the same fee as residents of Ohio.

Former students, who do not pay this fee until the third day of the first semester and the second day of the second semester, must pay one dollar additional. For each day of delinquency thereafter, fifty cents is added.

**Laboratory Fees**—A fee of two dollars a semester is charged for all laboratory courses using gas, water, electrical current or steam. For all other courses which are not purely lecture courses, a laboratory fee of one dollar is charged. Students are required to pay for all materials consumed in laboratory work. To meet the cost of these materials a deposit for each course requiring such supplies is made at the Bursar's office before the work is begun. In Chemistry the deposit is ten dollars. In other courses it varies with the amount of materials used. All laboratory supplies are sold at the General Store Room ,Chemistry Hall, to students at first cost to the University, and charged against the deposits. Any unused part of the deposit is refunded at the end of the semester.

### OTHER EXPENSES

**Locker Fee**—The gymnasium is free to all students, but those desiring to use a locker are charged a fee of two dollars a semester, which includes the cost of towels.

**Cadet Uniform**—The uniform with which the members of the regiment are required to provide themselves costs (without overcoat) about thirteen dollars. New students are advised against the purchase of second-hand uniforms, and should not arrange for uniforms until so directed by the Military authorities. Contracts are made by the University with reliable firms to supply uniforms at reasonable prices.

The uniform is quiet in pattern, and may be worn in place of civilian dress.

**Changes in Subjects or Schedule**—After ten days from registration day changes in subjects or schedule, if made at the request of the student, shall be made only upon the payment of a fee of $1.00 for each change. Requests for changes for the second semester must be filed with the College Secretary on or before the third day of the semester, or the fee of $1.00 will be assessed for each change made at the request of the student.

**Graduation Fee**—A fee of five dollars, to cover expense of graduation and diploma, is required of each person receiving one of the ordinary degrees from the University, and this fee must be paid before the degree is conferred. A like fee of ten dollars is charged each person receiving one of the higher graduate degrees.

**Rooms and Board**—Furnished rooms can be rented at one dollar to one dollar and a half per week for each student, when two students occupy a room. Board at the restaurants and boarding clubs near the University costs from two dollars and seventy-five cents to three dollars and fifty cents per week. Board, with furnished rooms, can be obtained in private families at rates varying from five to six dollars per week.

**The Ohio Union**—A fee of one dollar a semester is paid by all male students at registration. This entitles the student to all privileges of the Union, consistent with the Constitution and House Rules governing it.

**Text-Books**—Students should not purchase text-books until they are advised by the instructors of their respective classes.

In order to meet all the neccessary expenses of registration, books, uniform and other expenditures incident to securing a room and board a student should come prepared to expend about fifty dollars during the first ten days of a semester. After that period his board and room rent will constitute the major part of his expenses.

The element of economy on the part of the student enters somewhat into the cost of pursuing laboratory courses. For this reason it is impossible to fix accurately the costs for a semester or a year. In pursuing the courses of the College of Engineering, it is not likely that a student could get through a year's work with an expenditure in fees of less than thirty ($30.00) dollars, nor is it likely that the amount would ever exceed fifty ($50.00) dollars, except in cases of fines being assessed for gross carelessness or needless destruction of property.

The total expense per year, exclusive of clothing and traveling expenses, is from $275 to $400, according to the degree of economy exercised by the student.

## SELF SUPPORT

There is a considerable amount of work upon the farm and in the shops and laboratories of the University which may be assigned to students on application. Preference is given to those studying Agriculture or one of the Engineering courses. *The University cannot promise work to all applicants.* Many students find work in private families, in offices, and in various occupations, by means of which they defray at least a portion of their expenses. A person of ability and energy, who is master of a trade or who can do good work of any kind, can generally find remunerative employment. It has seldom been found that any student of ordinary energy and industry was obliged to leave the University because of lack of money for necessary expenses, after having been sixty days on the ground—or long enough to inform himself as to the opportunities for securing employment. As an accommodation the Executive office coöperates as far as possible in this matter. The Y. M. C. A. offers its services in helping young men to secure employment. Very much depends, however, on the individual's power of initiative. Students should not come to the University expecting others to find places for them. They should report to the executive office from time to time as to their needs and their work. This will enable the authorities to be more helpful than otherwise would be possible.

A student devoting much of his time to earning his way will be unable to carry successfully the full amount of collegiate work. Such students should apply for the privilege of carrying reduced work. This, of course, means that the time required to obtain a degree will be extended to five or more years, according to the amount of work successfully carried each year.

**Consultation**—For consulation in regard to their status as members of the College of Engineering, or for the filing of petitions, changes of course, of class cards, adjustment of schedules and similar needs, students will apply to the Secretary, Mines Building, Room 131, from 10 to 11 a. m.

## Y. M. C. A.

The Young Men's Christian Association has come to occupy a prominent place in university life. It has a membership of about five hundred men, and is affiliated with the World's Student Christian Federation.

Religious meetings are held for men on Sunday afternoon; there are also frequent meetings for the promotion of social intercourse and good fellowship. Courses in systematic Bible study and in modern missions are offered. A most helpful feature of the work is that in the interest of new students at the opening of the school year. Desirable rooms and boarding places are found and posted for reference at the Association Office. Representatives of the Association meet the trains, assist students in finding satisfactory locations, and endeavor in every way to make them feel at home. The Employment Bureau helps to find work.

A copy of the Students' Handbook, giving information about Columbus, the University, and the various college organizations and activities, will be sent free to prospective students. For this handbook or for further information, address the General Secretary of O. S. U. Y. M. C. A., University Campus, Columbus, Ohio.

The Ohio State University Bulletin is issued at least fifteen times during the academic year; monthly in October, November, and June, and bi-weekly in December, January, February, March, April, and May.

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The Ohio State University Bulletin

VOLUME XVI JANUARY, 1912 NUMBER 19

# COLLEGE OF ENGINEERING

## 1912-13

PUBLISHED BY THE UNIVERSITY AT COLUMBUS

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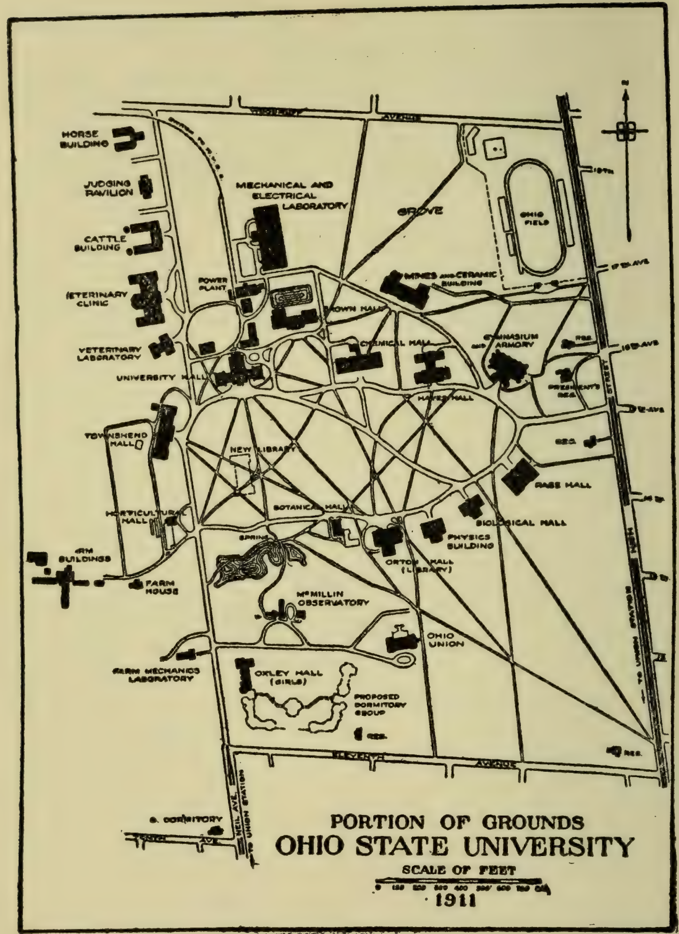

## PORTION OF GROUNDS
## OHIO STATE UNIVERSITY

1911

# THE OHIO STATE UNIVERSITY

The Ohio State University, located in Columbus, is a part of the public educational facilities maintained by the State. It comprises seven colleges and a graduate school:

The College of Agriculture,
The College of Arts, Philosophy and Science,
The College of Education,
The College of Engineering,
The College of Law,
The College of Pharmacy,
The College of Veterinary Medicine,
The Graduate School.

This bulletin of announcements is devoted exclusively to the work of the College of Engineering, offered during the academic year beginning September, 1912.

[NOTE—The University publishes a bulletin descriptive of each College. Copies may be obtained by addressing W. E. Mann, University Editor, Columbus, Ohio, and stating the college in which the writer is interested.]

# UNIVERSITY CALENDAR

## 1912

Entrance examinations, 8 a. m., Tuesday to Saturday, June 4 to 8.

Summer Session, June 17 to August 9.

Entrance examinations, 8 a. m., Tuesday to Saturday, September 10 to 14.

First Semester begins—Registration Day—Tuesday, September, 17.

President's Annual Address, Friday, September 20, 11 a. m.

Latest date of admission to candidacy for a degree at the Commencement of June 1913, Tuesday, October 1.

Date for mid-semester reports to the Deans concerning delinquent students, Saturday, November 23.

Thanksgiving recess begins November 27, 6 p. m., and ends December 2, 8 a. m.

Christmas recess begins Friday, December 20, 6 p. m.

## 1913

Christmas recess ends Thursday, January 2, 8 a. m.

Winter Courses in Agriculture and Dairying begin Monday, January 6.

First semester ends Thursday, February 6, 6 p. m.

Second semester begins—Registration Day—Tuesday, February 11.

Washington's Birthday, Saturday, February 22.

Easter recess, Thursday, March 20, 6 p. m., to Tuesday, March 25, 8 a. m.

Date for mid-semester reports to the Deans concerning delinquent students, Saturday, March 29.

Competitive Drill—Cadet Regiment—Saturday, May 24.

Memorial Day, Friday, May 30.

Final examinations, Thursday, May 29, to Thursday, June 5, (Excepting Friday, May 30.)

Entrance examinations, 8 a. m., Tuesday to Saturday, June 3 to 7.

Commencement, Wednesday, June 11.

## THE COLLEGE OF ENGINEERING

The purpose of the College of Engineering is to instruct students thoroughly in the fundamental sciences and arts upon which all engineering rests, and to impart such special and technical knowledge of the various branches of engineering as will enable students to enter them and maintain themselves while gaining their professional experience. In addition, it is believed that the severe mental discipline of the various courses of instruction makes the engineering curriculum fully the equal of any other in general educational value.

### COURSES LEADING TO BACHELOR DEGREES

This college offers instruction in seven important fields of engineering work. Covering these the following four-year courses of study are offered:

1. Architecture, leading to the degree of Bachelor of Architecture, (B. Arch.)
2. Ceramic Engineering, leading to the degree of Bachelor of Ceramic Engineering, (B. Cr. E.)
3. Chemical Engineering, leading to the degree of Bachelor of Chemical Engineering, (B. Ch. E.)
4. Civil Engineering, leading to the degree of Bachelor of Civil Engineering, (B. C. E.)
5. Electrical Engineering, leading to the degree of Bachelor of Electrical Engineering, (B. E. E.)
6. Mechanical Engineering, leading to the degree of Bachelor of Mechanical, Engineering, (B. M. E.)
7. Mine Engineering leading to the degree of Bachelor of Engineering in Mining, (B. E. M.)

These degrees will be conferred regularly for the first time in 1915. Students graduating before that time will receive degrees as published in prior issues of this bulletin, unless by special agreement between the faculty and students concerned.

## FIVE YEAR COURSES

For the benefit of those who are unable to carry the full schedule, on account of outside work for self-support, impaired health, or any other valid reason, any of the regular courses can be rearranged to cover five instead of four years.

## COMBINATION COURSES

It is also possible to arrange combination courses leading to two degrees (see page 32) in five or more years.

## GRADUATE COURSES

Advanced courses in various engineering subjects are offered, to those who wish to pursue them, by the Departments of the College of Engineering. If such courses are pursued with the expectation of receiving credit upon them to apply towards any higher degree, the student must register in the Graduate School, under whose jurisdiction all work for the higher degrees is conducted. For further information, consult the bulletin of the Graduate School of the University or confer with the Dean or Secretary.

## SHORT COURSES

The following two-year, or short courses, do not lead to a degree, but students completing them are furnished a formal certificate stating the work they have accomplished:

1. Clay-working.
2. Industrial Arts.
3. Mining.

# CORPS OF INSTRUCTION

## EXECUTIVE

William Oxley Thompson, D. D., LL. D., President of the University.

Carl E. Steeb, B. Ph., Secretary of the Board of Trustees.

Edward Orton, Jr., E. M., Dean of the College of Engineering.

Edwin F. Coddington, C. E., Ph. D., Secretary of the College of Engineering.

Edith D. Cockins, B. A., Registrar.

Olive Branch Jones, B. A., Librarian.

## ARCHITECTURE

Joseph Nelson Bradford, M. E., Professor.

Charles St. John Chubb, Jr., C. E., (Arch.), Associate Professor.

F. H. Haskett, Instructor.

Albert Field, Student Assistant.

## ASTRONOMY

Henry Curwen Lord, B. Sc., Professor.

Edmund S. Manson, Jr., S. M., Associate Professor.

## CERAMIC ENGINEERING

Edward Orton, Jr., E. M., Professor.

*Ross C. Purdy, Cer. E., Professor.

Homer F. Staley, B. Sc., Assistant Professor.

Carl B. Harrop, E. M., Instructor.

Amos P. Potts, Instructor.

## CHEMISTRY

William McPherson, D. Sc., Ph. D., Professor.

Sidney Augustus Norton, Ph. D., LL. D., Emeritus Professor.

William Edwards Henderson, Ph. D., Professor.

Charles William Foulk, B. A., Professor.

William Lloyd Evans, Ph. D., Professor.

James Renwick Withrow, Ph. D., Associate Professor.

John Wilkinson, Ph. D., Instructor.

David Raymond Kellogg, M. A., Instructor.

Cecil Ernest Boord, M. A., Assistant.

George Weatherworth Stratton, M. A., Assistant.

Edgar John Witzemann, M. A., Assistant.

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*Resigned. Effective July 1, 1912.

A. W. DAVISON, M. A., Assistant.
G. E. VAN SICKLE, M. A., Assistant.
MARGARET MACLEAN, M. A., Assistant.
E. E. HOCKETT, B. A., Fellow.
T. E. FOGLESANG, B. A., Fellow.
H. B. WEISER, B. A., Fellow.
R. C. HUMMEL, B. A., Fellow.
E. S. WALLACE, B. A., Fellow.
A. E. HARDGROVE, B. A., Fellow.
H. B. FRONING, B. A., Fellow.
JESSE S. DAY, B. A., Fellow.
HOMER D. HOLLER, B. A., Fellow.

## CIVIL ENGINEERING

CHRISTOPHER ELIAS SHERMAN, C. E., Professor.
FRANK HARVEY ENO, B. S., C. E., Professor.
CLYDE T. MORRIS, C. E., Professor.
ROY K. SCHLAFLY, C. E., Assistant Professor.
JOHN ROSS CHAMBERLIN, Assistant Professor.
HARRY WALTER STERTZBACH, C. E., Instructor.
KENNETH B. WARD, C. E., Instructor.
ROBERT N. WAID, C. E., Instructor.
JULIAN GRIGGS, C. E., Lecturer.
H. C. MCCALL, Assistant.

## ELECTRICAL ENGINEERING

FRANCIS CARY CALDWELL, B. A., M. E. in E. E., Professor.
JOHN HERMAN HUNT, B. S. in E. E., Professor.
ALBERT HENRY HEITMANN, M. E. in E. E., Instructor.
JOHN ERNEST SHEPARDSON, B. S., Assistant.
JAMES MAINLAND, A. B., E. E., Assistant.

## ENGINEERING DRAWING

THOMAS EWING FRENCH, M. E., Professor.
ROBERT MEIKLEJOHN, M. E., Assistant Professor.
OWEN ETSEL WILLIAMS, Instructor.
ARTHUR C. HARPER, M. E., Instructor.
WILLIAM JAMES NORRIS, Instructor.
CREE SHEETS, C. E., (Arch.), Instructor.
FREDERICK W. IVES, B. S. in M. E., Instructor.
WILLIAM D. TURNBULL, C. E., Instructor.
EDWARD J. GILBERT, M. E., Instructor.
H. J. A. GERARD, Student Assistant.

## ENGLISH

Joseph Villiers Denney, M. A., Professor.
George H. McKnight, Ph. D., Professor.
William Lucius Graves, M. A., Associate Professor.
*Carson Samuel Duncan, M. A., Assistant Professor.
Louis Albion Cooper, B. A., Assistant Professor.
Harry F. Harrington, M. A., Assistant Professor.
Edwin L. Beck, M. A., Assistant Professor.

## GEOLOGY

Charles Smith Prosser, D. Sc., Ph. D., Professor.
John Adams Bownocker, D. Sc., Professor.
Thomas M. Hills, B. Ph., Assistant Professor.
William Clifford Morse, M. A., Instructor.

## GERMAN

M. Blakemore Evans, Ph. D., Professor.
Berthold August Eisenlohr, M. A., Associate Professor.
†May Thomas, Ph. D., Assistant Professor.
Sarah Tracy Barrows, M. L., Assistant Professor.
Ludwig Lewisohn, M. A., Assistant Professor.
Robert Oscar Busey, M. A., Instructor.

## INDUSTRIAL ARTS

Frank Edwin Sanborn, S. B., Professor.
William Abner Knight, M. E., Associate Professor.
Charles Philip Crowe, Instructor.
Clement Medary Beem, Instructor.
Allando A. Case, Instructor.
Ulysses Wallace Denman, Assistant.
A. A. Emrick, Assistant.
Jacob A. Foust, Assistant.

## MATHEMATICS

*Rosser Daniel Bohannan, B. Sc., C. E., E. M., Professor.
George Washington McCoard, M. A., Professor.
Karl Dale Swartzel, M. Sc., Professor.
Harry Waldo Kuhn, Ph. D., Professor.

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*Absent on leave 1912-1913.
†Absent on leave one semester.

CHARLES LINCOLN ARNOLD, M. SC., Associate Professor.
SAMUEL EUGENE RASOR, S. M., Associate Professor.
JOHN BOWKER PRESTON, M. A., Assistant Professor.
GRACE MARIE BAREIS, B. A., Assistant Professor.
CHARLES CLEMENT MORRIS, M. A., Assistant Professor.
CARL JOSEPH WEST, M. A., Assistant Professor.
HORTENSE RICKARD, B. A., Assistant.
CLARENCE HEBBERT, B. SC., Fellow.

## MECHANICAL ENGINEERING

WILLIAM THOMAS MAGRUDER, M. E., Professor.
*EMBURY ASBURY HITCHCOCK, M. E., Professor.
HORACE JUDD, M. E., M. SC., Associate Professor.
ALEXANDER VALLANCE, M. E., Assistant Professor.
CORY C. MCCLELLAND, M. E., Assistant.
A. L. HOPKINS M. E., Assistant.
GEORGE H. TAPPAN, A. B., Student Assistant.

## MECHANICS

JAMES ELLSWORTH BOYD, M. S., Professor.
EDWIN F. CODDINGTON, C. E., Ph. D., Associate Professor.
HIRAM S. PERRY, B. A., Student Assistant.

## METALLURGY AND MINERALOGY

EDWARD ELSWORTH SOMERMEIER, G. Ph., Professor.
DANA JAMES DEMOREST, B. Sc. (Chem.), Assistant Professor.
WILLIAM J. MCCAUGHEY, B. Sc. (Chem.), Assistant Professor.

## MILITARY SCIENCE AND TACTICS

GEORGE L. CONVERSE, U. S. A., (Ret.), Professor.

## MINE ENGINEERING

FRANK ARNOLD RAY, E. M., Professor.
WELLS H. MINOR, E. M., Assistant Professor.
IRA CALLENDER, Student Assistant.
C. M. SHINN, Student Assistant.
G. G. BARR, Student Assistant.

## PHYSICAL EDUCATION

H. SHINDLE WINGERT, M. D., Professor.

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* Absent on leave 1912-1913.

## PHYSICS

*ALFRED DODGE COLE, A. M., Professor.
ROBERT FRANCIS EARHART, Ph. D., Associate Professor.
F. C. BLAKE, Ph. D., Assistant Professor.
CHARLES SHEARD, A. M., Assistant Professor.
ALPHEUS WILSON SMITH, Ph. D., Assistant Professor.
S. J. BARNETT, Ph. D., Assistant Professor.
HERMAN GUSTAVUS HEIL, Ph. B., Instructor.
DWIGHT A. WOODBURY, A. M., Instructor.
GEORGE O. WEIMER, M. E. in E. E., Assistant.
FRANK W. POTE, B. S. in E. E., Assistant.
W. M. FENNINGER, B. Ph., Fellow.
ALBERT C. ECKERT, A. B., Fellow.
A. K. CHAPMAN, Fellow.

## ROMANCE LANGUAGES AND LITERATURES

BENJAMIN LESTER BOWEN, Ph. D., Professor.
*CHARLES A. BRUCE, B. A., Professor.
EDGAR SHUGERT INGRAHAM, Ph. D., Associate Professor.
THEODORE ELY HAMILTON, Ph. D., Assistant Professor.
ROBERT C. ROCKWOOD, B. A., Instructor.
GEORGE S. CHAPIN, B. A., Instructor.
OTTO F. BOND, B. A., Assistant.

# ADMISSION

Applicants for admission must be at least seventeen years of age. The College is open on equal terms to both sexes.

## THE ENTRANCE BOARD

The admission of students to the University is in charge of the Entrance Board which determines the credit which shall be issued on all entrance examinations and certificates, and furnishes all desired information to applicants. Correspondence relating to admission should be addressed to the Entrance Board, Ohio State University, Columbus.

## ADMISSION TO COURSES LEADING TO DEGREES

There are two modes of admission to courses leading to degrees: (a) by examination (b) by certificate.

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*Absent on leave 1912-1913.

## ADMISSION BY EXAMINATION

The Entrance Board will conduct entrance examinations June 4 to 8, and September 10 to 14, 1912. Part of the examinations may be taken in June and the remainder in September. All applicants for admission who do not possess certificates covering entrance requirements must take examinations for admission.

SCHEDULE OF EXAMINATIONS. The hours for examinations are 8 A. M. and 1 P. M. Students intending to take any of the examinations scheduled in any given half day must appear within one hour of the time set for the examination. Students applying for examination will first go to the office of the Entrance Board, 100 University Hall, for registration.

| | | |
|---|---|---|
| Tuesday | A. M. | History: Ancient and Medieval (to 814 A. D.), Medieval and Modern (after 814 A. D.), English. |
| " | P. M. | English Composition and Rhetoric, English Classics, Chemistry. |
| Wednesday | A. M. | Algebra, Physical Geography. |
| " | P. M. | Plane Geometry, German, Spanish. |
| Thursday | A. M. | Civil Government, Solid Geometry, Zoölogy. |
| " | P. M. | Beginning Latin and Cæsar, Elements of Agriculture, Trigonometry, Commercial Geography. |
| Friday | A. M. | Physics, Physiology, Botany. |
| " | P. M. | American History, French, English Literature. |
| Saturday | A. M. | Vergil, Cicero, Domestic Science. |

A speciall bulletin of Entrance Information will be mailed on request. Address The University Editor.

## ADMISSION BY CERTIFICATE

Applicants may be admitted without examination on presentation of properly endorsed certificates from such secondary schools as have been accredited or recognized by the University, or from approved normal schools, or from the State Board of School Examiners under the following provisions:

(a) If from secondary schools, the certificate must show that the applicant is a graduate in good standing of the school issuing it; and also must state in detail the studies pursued, the text-books used, the amount of work done in each study, the amount of time devoted to it, and the fact that the applicant has passed in the work.

(b) Any entrance requirement not covered by a certificate must be met by examination.

Blank certificates may be obtained by addressing the Secretary of the Entrance Board. Certificates should be filled out by the proper official and returned to the University as early as possible after the close of schools in June.

## REQUIREMENTS BY UNITS

To obtain full standing in the College of Engineering, applicants under twenty-one years of age must have credit by examination or certificate for fifteen units. A unit is the equivalent of a course of study covering a school year, during which one hundred and twenty clock-hours are devoted to class-room work on the study. Two hours in the laboratory are equivalent to one hour in the class-room.

Of these fifteen units, not less than three shall be English, one history, three mathematics (including solid geometry), one physics, four language (other than English), and the balance shall be elective, all to be taken from the following list. A study listed as a half unit will be counted merely as such even if the course has extended for more than a half year. A study listed as one-half or one unit will be given either rating, depending upon the length of the course. On a study listed as one unit, no credit will be given for less than a year's work. In foreign language no credit will be given for less than two units.

In foreign languages, six units are required in the preparatory school and college combined. These six units may be done wholly in the preparatory school, or partly in the preparatory school and partly in college, in which case at least two units must be done in college, or under some circumstances the entire six units may be done in college. They may be taken in any one of the three modern languages or any combination of the five ancient and modern languages, offered below, provided that not less than two units of any single language be offered.

| | |
|---|---|
| English (Foreign students may substitute their native language for the English requirement.) | 1, 2, 3, or 4 units |
| American History or American History and Civil Government | 1 unit |
| Ancient History (Greek and Roman) and Medieval History to 814 A. D. | 1 unit |
| Medieval and Modern History (from 814 A. D. to the present) | 1 unit |

(For the present General History may be counted as a unit, but not in addition to Ancient or Medieval and Modern History.)

| | |
|---|---|
| English History | 1 unit |
| Algebra (through quadratics) | 1 unit |
| Algebra (beyond quadratics) | ½ unit |
| Geometry (plane) | 1 unit |
| Geometry (solid) | ½ unit |
| Trigonometry | ½ unit |
| Latin | 2, 3, or 4 units |
| Greek | 2, 3, or 4 units |
| German | 2, 3, or 4 units |
| French | 2, 3, or 4 units |
| Spanish | 2, 3, or 4 units |
| Physics | 1 unit |
| Chemistry | 1 unit |
| Physical Geography | 1 unit |
| Zoölogy | 1 unit |
| Botany | 1 unit |
| Physical Geography<br>Zoölogy<br>Botany<br>Physiology | For the present any two of these may be counted together as 1 unit |
| Agriculture<br>*Free-hand drawing<br>Manual Training<br>Domestic Science<br>Commercial Geography | The Entrance Board may, after investigating each claim, grant a total credit of not to exceed 2 units |

No student under twenty-one years of age will be admitted to college if he is conditioned in more than two of the fifteen units. An applicant twenty-one years of age or over may be admitted with a total deficiency of four units. Of these four units, all may be in foreign language, but not more than two units may be in subjects other than foreign language.

Students over twenty-one of years age may also be admitted as special students in accordance with the provisions stated under "Admission to Special Studies."

The extent and character of the work required in each subject mentioned above is explained in a special bulletin entitled "Definitions of Entrance Units," which will be sent by the University Editor to any address, upon request.

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*Students expecting to enter the College of Engineering are advised to take free-hand drawing in the high school.

## REMOVAL OF ENTRANCE CONDITIONS

The removal of entrance conditions is administered by the Entrance Board. Conditions may be removed (1) by examination or (2) by the substitution of excess work in other approved subjects, or (3) by the substitution of other equivalent work to be done at the University. All entrance conditions must be removed within two years after admission. If, at the end of the first year, a student still has entrance conditions outstanding, the Secretary of the College will assign such college courses as may be deemed a fair equivalent for the work in which the student has entrance conditions. A condition in physics must be removed before entering on the work of the second year. (See also statement on page 13 on foreign languages.)

## ADMISSION WITH ADVANCED STANDING

Applicants who have completed at least one year's work of collegiate rank in an approved college, and who bring official and explicit certificates describing their course of study and scholarship, and letters of honorable dismissal, will be admitted in accordance with either of two plans:

(1) The entrance units on which the candidate was admitted to the approved college will be accepted at their face value; deficiencies will be made up from the college credits presented, and advanced credit will be given for any remaining satisfactory work; or

(2) One year's work will be accepted in lieu of entrance units and the candidate will be admitted without examination and without conditions, but without any advanced standing on the year's work.

Applicants who have completed less than one year's work in an approved college must satisfy the entrance requirements in the usual way, and will then be given credit for any satisfactory work for which they can offer certificates.

## ADMISSION TO SPECIAL STUDIES

Students who desire to pursue special lines of work in the University, and do not intend to become candidates for degrees, will be admitted on the following conditions:

1. If the applicant can satisfy the entrance requirements, he should send to the Entrance Board for reference to the Executive Committee of the Engineering College a complete statement of the course which he wishes to take, together with his reasons for desiring this course and a detailed statement of his practical experience in engineering.

2. If he can not satisfy the entrance requirements but is at least twenty-one years of age, he *may* be admitted by the joint action of the Entrance Board and the Executive Committee of the Engineering College, provided he passes the entrance examination in algebra and plane geometry. Such a student must send a full statement of the course he wishes to pursue, his practical experience in engineering, and certificates from his employers giving the nature and duration of his experience.

3. Permission to enter as special undergraduates will be refused to all who fail to give satisfactory evidence of definiteness of purpose and will be withdrawn whenever the conditions on which it was granted cease to exist.

## ADMISSION TO THE SHORT COURSES

Applicants must be at least seventeen years of age and, unless they are over twenty-one years of age, must pass examinations in arithmetic and geography, and must be able to write a business letter or a short theme, correct in grammar and orthography; or they must present satisfactory certificates showing that they have successfully pursued these subjects elsewhere. In addition, each applicant under twenty-one years of age must present a letter or certificate showing that he has at least two years'consecutive practical experience in some industry related to the course which he wishes to pursue, and this certificate must be satisfactory to the Executive Committee of the College of Engineering.

Applicants over twenty-one years of age are admitted without examination, but must present a letter or certificate covering practical experience, as provided in the case of those less than twenty-one years of age.

# COURSES OF STUDY

## OUTLINE OF THE FIRST YEAR'S WORK OF ALL FOUR-YEAR COURSES

In order to permit all engineering students to have a year in which to ascertain their tastes more fully and find out definitely what courses they desire to pursue, the first year of all engineering courses is made uniform. While students are asked to indicate their choice of courses on entering the college, they can change at the end of the first year without any inconvenience.

NOTE—The figure in parenthesis following the name of each study indicates the number of the study in its department; the other figure indicates the number of credit hours.

| FIRST SEMESTER | | | SECOND SEMESTER | | |
|---|---|---|---|---|---|
| Mathematics<br>College Algebra and Trig. | (131) | 5. | Mathematics<br>Trig. and Analytics. | (132) | 5. |
| Chemistry<br>General Chemistry. | (105 or 109) | 4. | Chemistry<br>General Chemistry and Qualitative Analysis. | (106 or 110) | 4. |
| Modern Language<br>French, Ger., or Span. | | 4. | Modern Language<br>French, Ger., or Span. | | 4. |
| English<br>Paragraph Writing. | (101) | 2. | English<br>Paragraph Writing. | (104) | 2. |
| Engineering Drawing<br>Elementary Mechanical. | (101) | 2. | Engineering Drawing<br>Lettering and Projections. | (102) | 3. |
| Military Drill | | 1. | Military Drill | | 1. |
| Gymnasium | | 1. | Gymnasium | | 1. |

Students presenting Chemistry as an entrance subject will take Chemistry 109 and 110. Students with no entrance credits in Chemistry will take Chemistry 105 and 106.

SUMMER SESSION—Students electing courses named below are required to take courses in the Summer Session as follows:

CERAMIC ENGINEERING—Two from Shopwork (107), (109) and (115), at the close of the first year.

CHEMICAL ENGINEERING—Shopwork (109) and (115) at the close of the first or second year.

ELECTRICAL ENGINEERING, MECHANICAL ENGINEERING AND MINE ENGINEERING—Shopwork (109) and (115) at the close of the first year.

## ARCHITECTURE

The special architectural work of the course commences in the second year with history of architecture which affords intruction in the principles governing design in classic, mediæval and renaissance work, and the proper use to be made of precedent. The history of architecture is accompanied by a course in drawing and design devoted to the ''orders'' and ''order problems.'' Courses involving class and drawing room work are given during this year in shades and shadows, and architectural perspective.

Throughout the third and fourth years practical designing courses are given, which include problems relating to residences, apartment houses, school buildings, public buildings, tall steel constructed office buildings, and ecclesiastical structures. Decoration, architectural composition, working drawings, and structural details are covered in separate courses during the third year, while monumental design, specifications, estimating, sanitary plumbing, and professional practice are studied in the fourth year.

Drawing, both free hand and mechanical, is very essential to the architect. Thus, in addition to the extensive practice which the student gets in his designing, a series of courses in drawing and allied subjects runs through the four years.

On the structural side courses are given in trusses, cement work, masonary, steel construction, reinforced concrete, and surveying. Work in the testing of materials and in heating and ventilating is also given. A thesis, usually the complete plans and specifications for some important structure, is required before graduation.

A special bulletin describing more fully the work of this department will be mailed on request. Address the University Editor.

## COURSE IN ARCHITECTURE

FOR FIRST YEAR SEE PAGE 17.

### SECOND YEAR

| First Semester | | | Second Semester | | |
|---|---|---|---|---|---|
| Mathematics<br>Calculus | (141) | 5. | Mathematics<br>Calculus. | (142) | 5. |
| Engineering Drawing<br>Charcoal from Ornament. | (115) | 2. | Engineering Drawing<br>Pen Drawing. | (116) | 2. |
| Architecture<br>History of Architecture. | (101) | 3. | Architecture<br>History of Architecture. | (102) | 3. |
| Architecture<br>Order Problems. | (103) | 2. | Architecture<br>Order Problems. | (104) | 5. |
| Engineering Drawing<br>Descriptive Geometry. | (107) | 3. | Architecture<br>Shades, Shadows and Perspective. | (124) | 3. |
| Physics<br>General Physics. | (111) | 3. | | | |
| Military Drill | | 1. | Military Drill | | 1. |

Summer Course—Architecture (120), Architectural Practice, or an Architectural Problem.

### THIRD YEAR

| First Semester | | | Second Semester | | |
|---|---|---|---|---|---|
| Mechanics<br>Statics and Str. of Mater'ls. | (101) | 5. | Mechanics<br>Strength of Materials. | (104) | 2. |
| Engineering Drawing<br>Water Color. | (117) | 3. | Engineering Drawing<br>Charcoal from Antique. | (118) | 3. |
| Architecture<br>Design. | (107) | 5. | Architecture<br>Design. | (108) | 4. |
| Architecture<br>Decoration, etc. | (109) | 3. | Architecture<br>Working Drawings. | (110) | 4. |
| Architecture<br>Arch. Composition. | (113) | 2. | Architecture<br>Photography. | (112) | 2. |
| | | | Civil Engineering<br>Trusses. | (124) | 3. |

Summer Courses—Architecture (121), Architectural Practice, or an Architectural Problem.

### FOURTH YEAR

| First Semester | | | Second Semester | | |
|---|---|---|---|---|---|
| Architecture<br>Design. | (115) | 6. | Architecture<br>Design. | (114) | 3. |
| Architecture<br>Plumbing. | (117) | 1. | Architecture<br>Professional Practice. | (116) | 4. |
| Architecture<br>Masonry. | (119) | 2. | Civil Engineering<br>Surveying. | (128) | 2. |
| Civil Engineering<br>Tall Buildings. | (125) | 3. | Civil Engineering<br>Cement and Concrete. | (118) | 3. |
| Mechanical Eng.<br>Materials of Const. | (123) | 2. | Architecture<br>Thesis. | (118) | 5. |
| Mechanical Eng.<br>Heating and Ventilating. | (121) | 2. | | | |
| Engineering Drawing<br>Clay Modeling. | (119) | 2. | | | |

## CERAMIC ENGINEERING

Ceramic Engineering is the application of Chemistry and Engineering to a well defined group of non-metallic mineral industries, viz., clayworking, glass manufacture and cement manufacture. These industries all manufacture silicate products and employ the same raw material to a large extent, and thus constitute a natural division of chemical technology.

The ceramic engineer should be something of a geologist and mining engineer in order to discover and work his raw materials. He should be a mechanical engineer to prepare these materials and manufacture them into the required shape, and he must be a chemist to understand what takes place in kilns and furnaces. His course, while founded upon chemical technology, must still be broad and varied, and include a liberal amount of general engineering.

The technical work in ceramic engineering begins in the second year with a laboratory course running through the year, dealing with the chemical analysis of the various materials used in ceramic industries. During the last semester this is accompanied by a course in ceramic calculations. In the third year this work is continued by a course of lectures through the year, which cover the winning of the raw materials, their preparation and manufacture, and the drying, burning, and decoration of the ceramic products. In the fourth year, laboratory courses on the manufacture of ceramic bodies, the production of glazes, and the production of enamels and colors continue the ceramic training. However, a course on cement manufacture may be elected in place of the course on enamels and colors. In this year there is also a course on the drawing and design of ceramic structures. The ceramic subjects constitute about 35 per cent of the total work required for the degree.

## COURSE IN CERAMIC ENGINEERING

FOR FIRST YEAR SEE PAGE 17

### SECOND YEAR

| First Semester | | | Second Semester | | |
|---|---|---|---|---|---|
| Mathematics<br>Calculus. | (141) | 5. | Mathematics<br>Calculus. | (142) | 5. |
| Physics<br>Mechanics and Heat. | (113) | 5. | Physics<br>Elec., Light and Sound. | (114) | 5. |
| Engineering Drawing<br>Descriptive Geometry. | (103) | 3. | Engineering Drawing<br>Machine Sketching. | (104) | 3. |
| Ceramic Engineering<br>Ceramic Chemistry. | (101) | 5. | Ceramic Engineering<br>Laboratory. | (102) | 3. |
| | | | Ceramic Engineering<br>Ceramic Calculations. | (106) | 2. |
| Military Drill | | 1. | Military Drill | | 1. |

### THIRD YEAR

| First Semester | | | Second Semester | | |
|---|---|---|---|---|---|
| Mechanics<br>Statics and Str. of Materials. | (101) | 5. | Mechanics<br>Strength of Materials. | (104) | 2. |
| Chemistry<br>Physical Chemistry. | (157) | 3. | Chemistry<br>Physical Chemistry. | (158) | 3. |
| Mine Engineering<br>Mine Surveying. | (103) | 4. | Mechanical Eng.<br>Mechanism and Design. | (110) | 3. |
| Ceramic Engineering<br>Ceramic Manufacture. | (103) | 5, | Ceramic Engineering<br>Ceramic Manufacture. | (104) | 5. |
| Mine Engineering<br>Mine Trip | (109) | 1. | Ceramic Engineering<br>Phys. Chem. Measurements. | (108) | 3. |
| | | | Ceramic Engineering<br>Glazes and Colors. | (110) | 2. |

### FOURTH YEAR

| First Semester | | | Second Semester | | |
|---|---|---|---|---|---|
| Ceramic Engineering<br>Laboratory. | (111) | 5. | *Ceramic Engineering<br>Laboratory. | (112) | 5. |
| Ceramic Engineering<br>Drawing. | (113) | 2. | Ceramic Engineering<br>Drawing. | (114) | 3. |
| Mechanical Eng.<br>Laboratory and Lecture. | (171) | 4. | *Ceramic Engineering<br>Cement Lectures. | (118) | 5. |
| Civil Engineering<br>Trusses. | (123) | 3. | Civil Engineering<br>Cement and Concrete. | (118) | 3. |
| Metallurgy.<br>Gen. Metallurgy. | (109) | 4. | Geology<br>General Geology. | (168) | 3. |
| | | | Ceramic Engineering<br>Thesis. | (116) | 4. |

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*Alternative Courses. One must be taken.

## CHEMICAL ENGINEERING

The course in Chemical Engineering has been prepared to meet the growing demands for trained men in the numerous industries which employ chemical processes prominently in their work, and which are not included in the fields of metallurgy and ceramics. Among such may be mentioned the manufacture of acids, alkalies, salts, paints, dyes, soaps, glue, starch, sugar, preservatives, antiseptics, fertilizers, and others.

This course differs from the ordinary course in Chemistry in that it is extended greatly along engineering lines. There are four full years' work in consecutive chemical courses; elementary chemistry and qualitative analysis in the first year; advanced chemistry and quantitative analysis in the second, organic chemistry in the third, and physical and industrial chemistry in the fourth. In addition there are several smaller elective courses in chemistry, which the student may elect, and further chemical applications are given in another department in metallurgy, assaying and mineralogy.

In the engineering line, beside the usual fundamental work in mathematics, physics, mechanics and drawing, four weeks each of carpentry and forging is given in the first summer, a course in technical drawing, dealing chiefly with chemical machinery in the third year. This leads up to a course in machine design in the fourth year. There are also courses in power plants, and electrical machinery.

In addition to the elective work offered in the fourth year, three hours must be devoted to the preparation of a thesis.

## COURSE IN CHEMICAL ENGINEERING

FOR FIRST YEAR SEE PAGE, 17

### SECOND YEAR

| FIRST SEMESTER | | | SECOND SEMESTER | | |
|---|---|---|---|---|---|
| Mathematics<br>Calculus. | (141) | 5. | Mathematics<br>Calculus. | (142) | 5. |
| Physics<br>Gen. Physics. | (111) | 3. | Physics<br>Gen. Physics. | (112) | 3. |
| Engineering Drawing<br>Descriptive Geometry. | (103) | 3. | Engineering Drawing<br>Machine Sketching. | (104) | 3. |
| Chemistry<br>Quantitative Analysis. | (119) | 4. | Chemistry<br>Quantitative Analysis. | (120) | 4. |
| Chemistry<br>Adv. Gen. Chemistry. | (113) | 2. | Chemistry<br>Adv. Gen. Chemistry. | (114) | 2. |
| | | | Chemistry<br>Chemical Problems. | (124) | 1. |
| Military Drill | | 1. | Military Drill | | 1. |

### THIRD YEAR

| | | | | | |
|---|---|---|---|---|---|
| Mechanics<br>Statics and Str. Matr'ls. | (101) | 5. | Mechanics<br>Kinetics and Hydraulics. | (102) | 5. |
| Engineering Drawing<br>Technical Drawing. | (121) | 2. | Engineering Drawing<br>Technical Drawing. | (122) | 2. |
| Metallurgy<br>Gen. Metallurgy. | (109) | 4. | Metallurgy<br>Mineralogy and Cryst'g'phy. | (104) | 2. |
| Chemistry<br>Organic Chem., lec. | (151) | 2. | Chemistry<br>Organic Chem., lec. | (152) | 2. |
| Chemistry<br>Organic Chem., lab. | (153) | 2. | Electives<br>(See foot note.) | | 6 to 8 |
| Mechanical Eng.<br>Steam Power Plants. | (103) | 3. | | | |

### FOURTH YEAR

| | | | | | |
|---|---|---|---|---|---|
| Mechanical Eng.<br>Machine Design. | (127) | 5. | Mechanical Eng.<br>Machine Design. | (144) | 5. |
| Chemistry<br>Physical Chemistry. | (157) | 3. | Chemistry<br>Physical Chemistry. | (158) | 3. |
| Chemistry<br>Industrial Chemistry. | (177) | 2. | Chemistry<br>Industrial Chemistry. | (178) | 1. |
| Chemistry<br>Indust. Chem. lab. | (185) | 2. | Chemistry<br>Indust. Chem. lab. | (186) | 3. |
| Electrical Eng.<br>Elementary Elec. Eng. | (101) | 5. | Chemistry<br>Thesis. | (140) | 4. |
| | | | Elective<br>Chemistry (182 or 184) | | 2. |

Electives in third year, second semester, must be chosen from the following courses, subject to approval of the departments concerned: Chemistry (136) 2, Chemical Literature; Chemistry (154) 2 or 3, Advanced Organic Chemistry; Chemistry (168) 3 to 5, Advanced Qualitative Analysis; Chemistry (176) 3, Sanitary Analysis; Chemistry (188) 2 or 3, Inorganic Preparations; Metallurgy (110) 4, General Mettallurgy; Metallurgy (112) 2, Calorimetry and Mine Gas Analysis.

## CIVIL ENGINEERING

Among the special fields which are usually included under the title of civil engineering are those of the design, construction, and maintenance of bridges, railroads, municipal water supply, sewers, street paving, road building and other public works, irrigation projects, and river and harbor improvements. The civil engineer also superintends topographic and geodetic surveys and does other special lines of work.

The course of instruction is designed to provide the foundation upon which all of these specialties are built.

The technical work begins in the second year with courses in land and railroad surveying, accompanied by practice in the field, and by class-room work in topographic drawing. In the third year are courses in topographic surveying, a drawing room in timber construction and in stereotomy, a lecture and laboratory course in cement testing, and class-room courses in roads and streets, bridge stresses, and sanitary engineering. In the fourth year are given courses in bridge design, masonry structures, and reinforced concrete; also class-room courses in masonry construction, water supply engineering, and contracts and specifications. There is also an opportunity to select between a course in advanced bridge designing and one in railway location.

Distributed through the third and fourth years are courses in the applications of electrical machinery, least squares, astronomy, photography, water pumps and motors, testing of materials of construction, calibrations of weirs, and general geology. Most of these courses include laboratory practice. In each of the summers following the second and third years, four weeks of field practice in surveying is required, and before graduation, a thesis giving results of some original work along civil engineering lines.

## COURSE IN CIVIL ENGINEERING

FOR FIRST YEAR SEE PAGE 17

### SECOND YEAR

| FIRST SEMESTER | | | SECOND SEMESTER | | |
|---|---|---|---|---|---|
| Mathematics<br>Calculus. | (141) | 5. | Mathematics<br>Calculus. | (142) | 5. |
| Physics<br>Gen. Physics. | (111) | 3. | Physics<br>Gen. Physics. | (112) | 3. |
| Engineering Drawing<br>Descriptive Geometry. | (105) | 3. | Engineering Drawing<br>Advanced Descriptive Geom. | (106) | 3. |
| Civil Engineering<br>Land Surveying. | (101) | 4. | Civil Engineering<br>R. R. Survey and Field Prac. | (102) | 4. |
| Civil Engineering<br>Field Prac. & Top. Drawing. | (103) | 3. | Geology<br>Gen. Geology. | (168) | 3. |
| Military Drill | | 1. | Military Drill | | 1. |

SUMMER COURSES—Civil Engineering (104 and 111), each four weeks of six days per week. Field work in Surveying. Required in second and third years respectively.

### THIRD YEAR

| | | | | | |
|---|---|---|---|---|---|
| Mechanics<br>Statics and Str. of Mater'ls. | (101) | 5. | Mechanics<br>Kinetics and Hydraulics. | (102) | 5. |
| Civil Engineering<br>Topographic Surveying. | (105) | 3. | Civil Engineering<br>Timber Construction. | (108) | 3. |
| Civil Engineering<br>Stereotomy. | (107) | 3. | Civil Engineering<br>Roads and Streets. | (106) | 3. |
| Civil Engineering<br>Sanitary Eng. | (109) | 2. | Civil Engineering<br>Stresses in Structures. | (110) | 4. |
| Electrical Eng.<br>Elementary Elec. | (103) | 3. | Astronomy<br>Geodesy and Least Squares. | (104) | 3. |
| Architecture<br>Photography. | (111) | 2. | | | |

### FOURTH YEAR

| | | | | | |
|---|---|---|---|---|---|
| Civil Engineering<br>Bridge Design. | (113) | 4. | *Civil Engineering<br>Adv. Bridges. | (114) | 4. |
| Civil Engineering<br>Water Supply. | (117) | 3. | *Civil Engineering<br>Railways. | (112) | 4. |
| Civil Engineering<br>Masonry Construction. | (115) | 3. | Civil Engineering<br>Masonry Structures. | (116) | 3. |
| Astronomy<br>Geodesy and Least Squares. | (105) | 3. | Civil Engineering<br>Cement and Concrete. | (118) | 3. |
| Mechanical Eng.<br>Laboratory. | (173) | 5. | Civil Engineering<br>Contracts and Spec. | (120) | 2. |
| Civil Engineering | (119) | 1. | Mechanical Eng.<br>Mechanism and Mach. Des. | (140) | 2. |
| Thesis. | | | Civil Engineering<br>Thesis. | (122) | 4. |

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*Alternative Course. One must be taken.

## ELECTRICAL ENGINEERING

While there are few industries into which the application of electricity does not enter, there are several, such as electric railways, lighting and power, telephony and telegraphy, railroad signaling, shop drive, ect., and the manufacture of the corresponding forms of apparatus, which call especially for an electro-technical training.

Electricity and magnetism naturally constitute the most important studies of this course. This work begins in the second year in the physics department; in the third year it occupies nearly half of the time, and includes electrical measurements, direct current dynamo machinery, and a general course covering the applications of electricity in the first semester, and an introduction to alternating current apparatus in the second. In all of this work the laboratory plays an important part in the fourth year; the study of alternating current apparatus in class room and dynamo laboratory runs throughout the year. The design of dynamo machines runs through this year. Short courses are also given in electrical applications, transmission, railways, telephones, illumination, and wireless telegraphy.

Besides the work of first and second years, practice in drawing is obtained in the design work of the third and fourth years. Work in carpentry, forging, and the machine shop occupies four weeks of continuous time in the first summer and continues during the second year. The successful electrical engineer must be a good mechanical engineer. Thus, courses in mechanism, mechanical laboratory, power plants, engines and boilers, and machine design are distributed over the last two years. There are also some electives in the fourth year.

An important feature is the two inspection trips which are required in the junior and senior years.

## COURSE IN ELECTRICAL ENGINEERING

FOR FIRST YEAR SEE PAGE 17

### SECOND YEAR

| First Semester | | | Second Semester | | |
|---|---|---|---|---|---|
| Mathematics<br>Calculus. | (141) | 5. | Mathematics<br>Calculus. | (142) | 5. |
| Physics<br>Mechanics and Heat. | (113) | 5. | Physics<br>Elec., Light and Sound. | (114) | 5. |
| Engineering Drawing<br>Descriptive Geometry. | (103) | 3. | Physics<br>Laboratory. | (134) | 3. |
| Physics<br>Laboratory. | (133) | 2. | Engineering Drawing<br>Machine Sketching. | (110) | 2. |
| Shopwork<br>Machine Work. | (119) | 3. | Shopwork<br>Adv. Machine Work. | (122) | 3. |
| Military Drill | | 1. | Military Drill | | 1. |

### THIRD YEAR

| | | | | | |
|---|---|---|---|---|---|
| Mechanics<br>Statics and Str. of Materials. | (101) | 5. | Mechanics<br>Kinetics and Hydraulics. | (102) | 5. |
| Physics<br>Laboratory. | (135) | 5. | Electrical Eng.<br>D. C. Machinery. | (104) | 5. |
| Mechanical Eng.<br>Steam Power Plants. | (103) | 3. | Mechanical Eng.<br>Steam Engines. | (118) | 3. |
| Mechanical Eng.<br>Mechanism. | (101) | 3. | Mechanical Eng.<br>Laboratory. | (160) | 2. |
| Engineering Drawing<br>Technical. | (111) | 2. | Electrical Eng.<br>Applications A. C. Prin. | (106 & 108) | 3. |
| | | | Electrical Engineering (130) or<br>(134) Inspection Trip. | | |

### FOURTH YEAR

| | | | | | |
|---|---|---|---|---|---|
| Mechanical Eng.<br>Laboratory. | (175) | 3. | Electrical Eng.<br>A. C. Laboratory. | (112) | 3. |
| Electrical Eng.<br>A. C. Laboratory. | (111) | 3. | Electrical Eng.<br>Transmission. | (124) | 2. |
| Electrical Eng.<br>A. C. Machinery. | (109) | 3. | Industrial Arts<br>Machine Design. | (112) | 2. |
| Electrical Eng.<br>Elec. Machine Design. | (121) | 3. | Electrical Eng.<br>Inspection Trip. | (130 or 134) | |
| Electrical Eng.<br>Thesis. | (127) | 1. | Electrical Eng.<br>Thesis. | (128) | 5. |
| Electrical Engineering. | (*) | 2. | | | |
| Elective | | 2 to 4. | Elective | | 3 to 6. |

*One of the following: (113) Railways, (115) Telephones, (117) Illumination, (119) Wireless Telegraphy.

Students who, for financial or other satisfactory reasons, are unable to take Electrical Engineering 130 may substitute Electrical Engineering 134 upon receiving permission from the head of the department.

## MECHANICAL ENGINEERING

Mechanical engineering in its broadest meaning includes the invention, development, design, manufacture, and operation of all forms of machinery.

Apart from drawing and shopwork, the technical work in mechanical engineering begins in the first semester of the third year, with a descriptive course on power plants and followed by a more advanced course in steam engineering, accompanied by laboratory work and recitations and drawing practice in the principles of mechanism and mechanical movements. In the fourth year the steam engineering work is continued, with courses on gas engines and thermodynamics. A laboratory course runs throughout the fourth year, and covers the testing of materials of construction, steam, hot-air, and gas engines, power transmission, boilers, and injectors, air compressors, pumps and other hydraulic apparatus. The course in machine design runs through the year with lectures, recitations, and drawing-room practice in the applications. Courses on hydraulic machinery, and upon shop appliances and steam turbines, complete the list of mechanical engineering subjects.

Allied courses are given in the chemistry of fuels, the metallurgy of iron and steel, in timber and masonry constructions, the design of trusses, in differential equations, machinery and photography.

The two inspection trips, which are required in the junior and senior years, are an imporant feature. A thesis, giving the results of a piece of original work, is required.

## COURSE IN MECHANICAL ENGINEERING

FOR FIRST YEAR SEE PAGE 17.

### SECOND YEAR

| First Semester | | | Second Semester | | |
|---|---|---|---|---|---|
| Mathematics<br>Calculus. | (141) | 5. | Mathematics<br>Calculus. | (142) | 5. |
| Physics<br>Mechanics and Heat. | (113) | 5. | Physics<br>General Physics. | (112) | 3. |
| Engineering Drawing<br>Descriptive Geometry. | (103) | 3. | Engineering Drawing<br>Machine Sketching. | (104) | 3. |
| Shopwork<br>Foundry, Chipping, Filing. | (105) and (107) | 3. | Shopwork<br>Machine Work. | (120) | 3. |
| Shopwork<br>Adv. Pattern Making. | (111) | 2. | Physics<br>Laboratory. | (138) | 2. |
| | | | Civil Engineering<br>Surveying. | (128) | 2. |
| Military Drill | | 1. | Military Drill | | 1. |

### THIRD YEAR

| First Semester | | | Second Semester | | |
|---|---|---|---|---|---|
| Mechanics<br>Statics and Str. of Marter'ls. | (101) | 5. | Mechanics<br>Kinetics and Hydraulics. | (102) | 5. |
| Engineering Drawing<br>Technical Drawing. | (111) | 2. | Architecture<br>Photography. | (112) | 2. |
| Metallury<br>General Metallurgy. | (109) | 4. | Civil Engineering<br>Timber and Masonry. | (126) | 2. |
| Mathematics<br>Diff. Equations. | (151) | 1. | Mech. Eng.<br>Mechanism and Drawing. | (114 and 116) | 3 & 1. |
| Shopwork<br>Adv. Machine Work. | (121) | 3. | Mech. Eng.<br>Steam Engines and Boilers. | (118 & 120) | 3 & 1. |
| Mechanical Eng.<br>Steam Power Plants. | (103) | 3. | Mechanical Eng.<br>Laboratory. | (164) | 2. |
| | | | Mechanical Eng.<br>Inspection Trip. | (130 or 134.) | |

### FOURTH YEAR

| First Semester | | | Second Semester | | |
|---|---|---|---|---|---|
| Civil Engineering<br>Trusses. | (123) | 3. | *Industrial Arts<br>Shop Buildings. | (114) | 2. |
| Electrical Eng.<br>Elementary Elec. Eng. | (101) | 5. | *Mechanical Eng.<br>Steam Turbines. | (146) | 2. |
| Mechanical Eng.<br>Machine Design. | (127) | 5. | Mechanical Eng.<br>Machine Design. | (144) | 5. |
| Mechanical Eng.<br>Gas Engines and Producers. | (125) | 2. | Mechanical Eng.<br>Hydraulic Machinery. | (142) | 2. |
| Mechanical Eng.<br>Thermodynamics. | (129) | 2. | Mechanical Eng.<br>Laboratory. | (190) | 6. |
| Mechanical Eng.<br>Laboratory. | (179) | 2. | Mechanical Eng.<br>Thesis. | (148) | 3. |
| | | | Mechanical Eng.<br>Inspection Trip. | (130 or 134) | |

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*Alternative Courses. One must be taken.

Students who, for financial or other satisfactory reasons, are unable to take Mechanical Engineering (130) may substitute Mechanical Eng. (134) upon receiving permission from the head of the department.

## MINE ENGINEERING

The profession of mine engineering, which has for its main object the development and winning of mineral resources, is closely connected with that of metallurgy.

The special work in mine engineering proper begins in the second year with mine surveying in which, in addition to the instruction at the University, practice is given in actual surveying of coal mines accessible to Columbus. In the fourth year a course of lectures treats of the problems of mine engineering involved in opening, developing and equipping mining plants, and the prospecting, location and examination of mineral property and mining plants.

The special work in metallurgy begins in the second semester of the second year and comprises courses in the metallurgical laboratory, and one semester in mineralogy and crystallography. In the third year a course of lectures for both semesters treats of the principles of combustion, the valuation and the treatment of fuels, and the extraction and preparation of iron, steel, and other metals, including gold and silver. There is also work in advanced metallurgical laboratory, where special analytical methods, coal washing and ore dressing are studied by lectures and laboratory practice, also calorimetry and the microscopic examination of metals. In this year there is a one-semester course in determinative mineralogy and a one-semester laboratory course in the fire assaying of gold, silver, and other ores. In the fourth year there is a course in connection with the department of mine engineering on metallurgical construction covering the design of furnaces and other metallurgical machinery, and a course of lectures on ore dressing and coal washing.

## COURSE IN MINE ENGINEERING

FOR FIRST YEAR SEE PAGE 17.

### SECOND YEAR

| FIRST SEMESTER | | | SECOND SEMESTER | | |
|---|---|---|---|---|---|
| Mathematics<br>Calculus. | (141) | 5. | Mathematics<br>Calculus. | (142) | 5. |
| Physics<br>General Physics. | (111) | 3. | Physics<br>General Physics. | (112) | 3. |
| Engineering Drawing<br>Descriptive Geometry. | (103) | 3. | Engineering Drawing<br>Machine Sketching. | (104) | 3. |
| Chemistry<br>Quantitative Analysis. | (119) | 3. | Metallurgy<br>Laboratory. | (106) | 4. |
| Mine Engineering<br>Mine Surveying. | (103) | 4. | Metallurgy<br>Mineralogy and Cyrst'l'g'phy. | (104) | 3. |
| | | | Mine Engineerng<br>Mine Trip. | (110) | 1. |
| Military Drill | | 1. | Military Drill | | 1. |

### THIRD YEAR

| FIRST SEMESTER | | | SECOND SEMESTER | | |
|---|---|---|---|---|---|
| Mechanics<br>Statics and Str. of Mater'ls. | (101) | 5. | Mechanics<br>Kinetics and Hydraulics. | (102) | 5 |
| Metallurgy<br>Gen. Metallurgy. | (109) | 4. | Metallurgy<br>Gen. Metallurgy. | (110) | 4. |
| Metallurgy<br>Fire Assaying. | (105) | 3. | Metallurgy<br>Calorimetry, Mine Gas Anal. | (112) | 2. |
| Metallurgy<br>Laboratory. | (107) | 4. | Metallurgy<br>Determinative Mineralogy. | (108) | 3. |
| Geology<br>Gen. Geology. | (165) | 3. | Geology<br>Petrography. | (166) | 2. |
| | | | Civil Engineering<br>Trusses. | (124) | 3. |

### FOURTH YEAR

| FIRST SEMESTER | | | SECOND SEMESTER | | |
|---|---|---|---|---|---|
| Mine Engineering<br>Gen. Mining. | (105) | 5. | Mine Engineering<br>Gen. Mining. | (106) | 5. |
| Metallurgy<br>Metallurgical Const. | (111) | 2. | Mine Engineering<br>Plans and Specifications. | (104) | 4. |
| Metallurgy<br>Ore Dressing. | (113) | 2. | Metallurgy<br>Metallography, etc. | (114) | 3. |
| Electrical Eng.<br>Elementary Elec. | (103) | 2. | Mechanical Eng.<br>Laboratory. | (192) | 3. |
| Geology<br>Economic Geology. | (167) | 3. | *Mine Engineering<br>Thesis. | (116) | 3. |
| Architecture<br>Photography. | (111) | 2. | *Metallurgy<br>Thesis. | (116) | 3. |

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*Alternative courses. One must be taken.

## COMBINATION COURSES

Combination courses, leading to two engineering degrees, can be arranged for any two of the foregoing degrees. The amount of additional time will be at least thirty semester hours in excess of that required for one, and may be more. In no case will the student be required to take all of the work not common to the two courses as published.

For instance a joint course, Mechanical and Electrical Engineering, can be made in five years. Between courses more unlike, such as Civil Engineering and Mechanical Engineering, six years would be required.

## ARTS-ENGINEERING COURSES

For the benefit of those who desire to possess the advantage of a wider general culture and a broader foundation than can be given in the limits of a four-year professional course, a combination of three years in the College of Arts, Philosophy and Science and three years in the College of Engineering can be so adjusted as to enable both the Bachelor of Arts and Bachelor of the appropriate engineering courses to be taken. Negotiations are now in process with other institutions of approved standing in Ohio, seeking to establish the same relations with them.

## GRADUATE WORK

The University has organized a Graduate School which has administrative control of the whole subject of graduate work in all of the colleges of the University. The conditions under which advanced degrees can be obtained by graduates of the College of Engineering are as follows:

**Master's Degree.** The degree which will usually be conferred upon candidates whose major work lies in the college of Engineering will be that of Master of Science,(M. Sc.). The course of study will consist of one major and either one or two minors, at least one of the minors being in a different department from that in which the major is taken. A residence of one year devoted wholly to graduate work is required,but graduates of this University may do not to exceed one-half of the required work at another institution offering equivalent opportunities for study. Except in certain special cases, a satisfactory thesis is required.

**Professional Engineering Degrees.** Upon nomination by the Faculty of the College of Engineering, the appropriate professional engineering degree of Civil Engineer, Mechanical Engineer, Electrical Engineer, Engineer of Mines, Ceramic Engineer, Chemical Engineer, or Master of Architecture, may be granted to graduates of this University upon any one of the following plans:

First. Four years of acceptable professional experience and an approved thesis.

Second. A Master of Science degree from this University with a major in engineering, followed by two years of acceptable professional experience and an approved thesis.

Third. One year of acceptable professional experience, followed by one year of approved study at this University, with an appropriate engineering major, and the submitting of an approved thesis.

## COURSES NOT LEADING TO A DEGREE

The following short courses, of two years each, are offered by the College of Engineering to meet the needs of that class of young men who have for some reason failed to qualify themselves to enter the regular four year courses, but whose experience in engineering work has shown them the need of some technical education as a requisite to further progress. These courses are in no sense a substitute for the regular four-year courses,nor are they designed as preparation for subsequent entrance into the regular courses. They aim to give an introduction to the fundamentals of engineering only, and in the shortest time consistent with any real educational result.

Applicants for admission to these courses are required to have at least two years of consecutive practical experience in some branch of the industries related to the one they wish to pursue, and to present a satisfactory certificate to that effect. (See page 15.)

## SHORT COURSE IN CLAYWORKING

### FIRST YEAR

| FIRST SEMESTER | | | SECOND SEMESTER | | |
|---|---|---|---|---|---|
| Mathematics<br>Elementary Algebra. | (101) | 5. | Mathematics<br>Elementary Algebra. | (102) | 5, |
| Mathematics<br>Plane and Solid Geom. | (113) | 5. | Mathematics<br>Solid Geom. and Trig. | (114) | 5. |
| Chemistry<br>Elementary Chemistry. | (101) | 4. | Chemistry<br>Elementary Chemistry and Qualitative Analysis. | (102) | 4. |
| Engineering Drawing<br>Freehand and Lettering. | (113) | 4. | Engineering Drawing<br>Mechanical Drawing. | (114) | 3. |
| Military Drill | | 1. | Military Drill | | 1. |
| Gymnasium | | 1. | Gymnasium | | 1. |

*SUMMER SESSION—Students are required to take two of the following subjects: Shopwork (107) (109) and (115), during the Summer Session at the close of the first year.

### SECOND YEAR

| | | | | | |
|---|---|---|---|---|---|
| Ceramic Engineering<br>Ceramic Chemistry. | (101) | 5. | Ceramic Engineering<br>Clay Manufacture. | (104) | 5. |
| Ceramic Engineering<br>Clay Manufacture. | (103) | 5. | Ceramic Engineering<br>Glazes and Colors. | (110) | 2. |
| Ceramic Engineering<br>Laboratory. | (115) | 2. | Ceramic Engineering<br>Laboratory. | (126) | 5. |
| Physics<br>Elementary Physics. | (101) | 6. | Ceramic Engineering<br>Ceramic Calculations. | (106) | 2. |
| | | | Ceramic Engineering<br>Lab. in Calculations. | (120) | 1. |
| | | | Ceramic Engineering<br>Dryer and Kiln Design. | (122) | 2. |
| Military Drill | | 1. | Military Drill | | 1. |

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*Upon presention of reasons satisfactory to the head of the department students may substitute work in a ceramic factory for the above shopwork courses

## SHORT COURSE IN INDUSTRIAL ARTS

### FIRST YEAR

| First Semester | | | Second Semester | | |
|---|---|---|---|---|---|
| Mathematics<br>Elementary Algebra. | (101) | 5. | Mathematics<br>Elementary Algebra. | (102) | 5. |
| Mathematics<br>Plane and Solid Geom. | (113) | 5. | Mathematics<br>Solid Geom. and Trig. | (114) | 5. |
| Engineering Drawing<br>Freehand and Lettering. | (113) | 4. | Engineering Drawing<br>Mechanical Drawing. | (114) | 3. |
| Shopwork<br>Pattern Making. | (109) | 2. | Shopwork<br>Adv. Pattern Making. | (112) | 2. |
| Shopwork<br>Forging. | (115) | 2. | Shopwork<br>Foundry, Chipping, Filing. | (106 and 108) | 3. |
| Military Drill | | 1. | Military Drill | | 1. |
| Gymnasium | | 1. | Gymnasium | | 1. |

### SECOND YEAR

| | | | | | |
|---|---|---|---|---|---|
| Engineering Drawing<br>Descriptive Geometry. | (103) | 3. | Engineering Drawing<br>Machine Sketching. | (104) | 3. |
| Industrial Arts<br>Machines. | (101) | 3. | Industrial Arts<br>Machines. | (102) | 3. |
| Industrial Arts<br>Designing. | (103) | 2. | Industrial Arts<br>Designing. | (104) | 2. |
| Physics<br>Elementary Physics. | (101) | 6. | Industrial Arts<br>Strength of Materials. | (110) | 6. |
| Shopwork<br>Machine work. | (119) | 3. | Shopwork<br>Adv. Machine Work. | (122) | 3. |
| Military Drill | | 1. | Military Drill | | 1. |

## SHORT COURSE IN MINING

### FIRST YEAR

| First Semester | | | Second Semester | | |
|---|---|---|---|---|---|
| Mathematics<br>Elementary Algebra. | (101) | 5. | Mathematics<br>Elementary Algebra. | (102) | 5. |
| Mathematics<br>Plane and Solid Geom. | (113) | 5. | Mathematics<br>Solid Geom. and Trig. | (114) | 5. |
| Physics<br>Elementary Physics. | (101) | 6. | Shopwork<br>Forging | (116) | 2. |
| | | | Geology<br>Elementary Physiography. | (162) | 4. |
| Military Drill | | 1. | Military Drill | | 1. |
| Gymnasium | | 1. | Gymnasium | | 1. |

### SECOND YEAR

| | | | | | |
|---|---|---|---|---|---|
| Engineering Drawing<br>Freehand and Lettering. | (113) | 4. | Engineering Drawing<br>Mechanical Drawing. | (114) | 3. |
| Chemistry<br>Elementary Chemistry. | (101) | 4. | Geology<br>Elementary Geology. | (164) | 3. |
| Mine Engineering<br>Mine Plans. | (107) | 2. | Metallurgy<br>Water Supply and Mine Gases. | (102) | 4. |
| Mine Engineering<br>Mine Surveying, | (101) | 5. | Mine Engineering<br>General Mining. | (102) | 5. |
| Military Drill | | 1. | Military Drill | | 1. |

# GROUNDS AND BUILDINGS

The grounds of the University are located about two miles north of the Union Station and extend west from High Street for nearly a mile. They may be reached by the car lines on either High Street or Neil Avenue. The campus proper lies along High Street and contains about one hundred acres. To the west of this lies the University farm which, combined with the campus, has an area of 439 acres. As seen from the map (page 2) the twenty-nine larger buildings, valued at over one and a quarter million dollars, are irregularly arranged near the center of the campus, leaving a roughly oval space in the center. Three of the buildings, Brown Hall, the School of Mines, and the Robinson Laboratory are used exclusively for the work of the College of Engineering and are located near each other and near the power plant in the northwestern portion of the grounds. Besides these, the three other buildings described below are largely used by the students of this college, and others to a less degree.

A bulletin containing views of the buildings and laboratories in which engineering instruction is given may be obtained by addressing the University Editor.

## BROWN HALL

Of the three buildings which are entirely occupied with the work of the College, the oldest is Brown Hall, a handsome brick structure named after the second Dean of the College of Engineering. This building was completed in 1904 at a cost of $75,000. The main part of this building is 217 by 50 feet, and there are two short wings extending to the rear. It accommodates the departments of Architecture, Civil Engineering, and Engineering Drawing.

## THE SCHOOL OF MINES

This building was completed in 1906, and cost $85,000. It is 270 feet long by 70 feet wide with two one-story fireproof wings for the accommodation of furnace work. This building accommodates the departments of Ceramic Engineering, Metallurgy, Mechanics and Mine Engineering. The basement, which is wholly above grade, is used for laboratories and there are also a number of laboratories on the first and second floors. These floors also accommodate the lecture rooms, drawing rooms, and offices.

## THE ROBINSON LABORATORY

This is a building of modern shop construction with sawtooth roof, made up of one forty-eight-foot and seven thirty-foot divisions. These, together with enclosed galleries at the sides, make a total length of 310 feet, with a depth of 112 feet. The enclosed galleries and the space under them are used for special laboratories, museums, classrooms, and offices. The central sections are lighed by skylights with northern exposure, and are occupied by the different laboratories of the Mechanical and Electrical Engineering departments, and by an amphitheatre suitable for demonstration work, which is used by both departments. This building, which has just been completed, cost $75,000, exclusive of equipment, and is one of the most practical laboratory buildings in the country. It is named in honor of Dr. Stillman W. Robinson, first professor of Mechanical Engineering in this University.

## HAYES HALL

This building was named in honor of President Rutherford B. Hayes, at one time a trustee of the University. It is at present occupied by the departments of Industrial Arts and Domestic Science. This building, which was completed in 1893, is irregular in shape, with a frontage of 166 feet and greatest depth of 144 feet. The central section of the building is occupied by the machine and carpenter shops, foundry, forge room, offices and drawing rooms.

## CHEMISTRY HALL

In this building is given all the instruction in pure chemistry, and also the technical courses in chemical engineering. The building was completed in 1907, at cost of $100,000. It has a frontage of 200 feet and a depth of 70 feet, with laboratories, lecture rooms, offices, etc., occupying two stories and a high basement. It has one of the finest equipments in the University. (See also Chemical Engineer ing).

## PHYSICS HALL

This building is devoted to the work of the Physics Department. It is 105 feet long by 102 feet in its greatest depth, with three stories and a high basement. It was recently erected at a cost of $80,000, and is equipped with forty thousand dollars worth of modern apparatus. A large part of the basement is given to the laboratory work in electrical measurement.

## OBSERVATORY

The Emerson McMillin Observatory is the gift of Emerson McMillin of New York City. It is located in the southern part of the grounds, and is provided with excellent equipment for purely scientific research, or for the teaching of astronomy in its engineering aspects

## ORTON HALL

This building was erected for the Department of Geology and represents in itself the building stones of Ohio, most of the characteristic varieties of which were used in its construction. For the equipment, see Geological Department.

## LIBRARY

A new Library building, costing with its equipment, exclusive of books, $300,000. is nearly completed and it is expected that it will be occupied in the fall of 1912. The University Library consists of approximately 114,000 bound volumes and 8000 unbound publications. The main part of the books are kept in the Library, but there are important branch libraries in Chemistry in the Chemical Building; in Mining, Metallurgy and Ceramic Engineering in the Mines Building; in Electrical Engineering and Mechanical Engineering in the Robinson Laboratory,and some smaller ones in other departments.

## UNIVERSITY HALL

In this building, which is the oldest on the grounds, the greater part of the work in mathematics and language is given. This building also contains the office of the President, the Secretary of the Board of Trustees, and the Registrar.

## THE GYMNASIUM AND ARMORY

The Gymnasium and Armory is a beautiful building erected in 1898 at a cost of $115,000. Its main floor is 80 by 150 feet clear, and there is a gallery twelve feet above the floor, containing a running track, and seats for about seven hundred persons. The basement contains another gymnasium room 80 x 40 feet, also used by the Military Department a portion of the time for a target range. The men's locker room contains 640 lockers and the women's, 115. The building is well equipped with gymnastic apparatus, shower baths, and swimming pools for men and for women. The headquarters, officers' quarters, band room, and gun racks of the Military Department are located in this building.

## POWER HOUSE

The University provides the light, heat and power for all of its buildings from a central station. There is a boiler house 38 by 100 feet, with four 150, one 450, and one 500 horse-power watertube boilers, equipped with turbine, steam-driven feed pumps, automatic stokers, and coal and ash-handling apparatus. Fuel is brought to the University over a spur from the Hocking Valley Railway, about three-quarters of a mile long. The cars are unloaded by a locomotive crane, with clam-shell unloader. The coal is dropped by this apparatus into the chutes of the coal-handling system, which carries it to the boilers, or is dumped in concrete coal-storage bins, 40 by a 100 feet in area. Near the boiler house is the engine house, 40 by 60 feet, with an L, 30 by 40 feet, equipped with the following: Two 125 kilowatt two-phase direct-connected steam units, one 100 kilowatt gas engine unit, one 300 kilowatt turbo-generator set, one 15 kilowatt exciter set, and two small air compressors; the hot water heating apparatus located in the L utilizes exhaust steam for heating eight buildings, and consists of the following: One large exhaust heater, one live steam heater, one turbine pump, and one surface condenser. The power and boiler houses are connected through a large tunnel with nearly all the buildings of the University, and through this tunnel run the pipes for steam, water, and gas, as well as the electrical distribution system for light and power. The power plant is a strictly modern and efficient equipment, and of value as an object lesson to all students of engineering.

# THE DEPARTMENTS OF INSTRUCTION

## ARCHITECTURE

(Office, Room 22, Brown Hall)

PROFESSOR BRADFORD, ASSOCIATE PROFESSOR CHUBB, MR. HASKETT

### EQUIPMENT

The department occupies the west end of Brown Hall, where it is provided with large, well lighted designing rooms, a lecture room with projection lantern, library, and office.

In the designing rooms, each student is provided with a drawing table and locker for his exclusive use. The equipment includes a fine collection of plaster casts of architectural orders, carved ornament and statuary, including a set by Caproni from the noted monuments of ancient and mediæval architecture, two thousand lantern slides of the masterpieces of architecture, a collection of large photographs, a collection of portfolios of noted architectural plates, drawings and specifications of erected structures, samples of building materials, fixtures, etc. The library has a good collection of standard works and bound volumes of the standard periodicals.

The courses in photography are given in this department. The laboratory for this work is one of the best in the country and includes a dark room which will accommodate forty students working at the same time, each with a complete and separate stall. There is a printing and toning room, and also a room for indoor and special work. Equipment of note consists of fourteen high-grade view cameras fitted with fine lenses, also shutters, color screens. and exposure meters, a Bausch and Lomb photo-micrographic apparatus of the finest quality, special photographic arc lamps, and three copying cameras. There is an enlarging room equipped for handling any work up to the largest practical sizes, and also a separate blue printing room equipped with a modern cylindrical arc lamp, blue printing machine, also washing tanks, drying racks, etc.

## SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**101. History of Architecture.** Three credit hours. Architecture, second year, first semester.

Lectures, illustrated by lantern slides.

**102.** Continuation of 101. Architecture, second year, second semester.

**103. Order Problems.** Two credit hours. Architecture, second year, first semester. Prerequisite, Engineering Drawing 102, Concurrent with Engineering Drawing 107.

Drawing details of the Orders.

**104. Order Problems.** Five credit hours. Architecture, second year, second semester. Prerequisite, Architecture 103.

**107. Design.** Five credit hours. Lectures and practice. Architecture, third year, first semester. Prerequisite, Architecture 104, and concurrent with Architecture 113.

**108. Design.** Four credit hours. Architecture, third year, second semester. Prerequisite, Architecture 107.

**109. Decoration and Ornament.** Three credit hours. Architecture, third year, first semester. Prerequisite, Architecture 104 and Engineering Drawing 115.

**110. Working Drawings.** Four credit hours. Architecture, third year, second semester. Prerequisite, Architecture 107.

**111. Photography.** Two credit hours. Civil Engineering, third year, first semester; Mine Engineering, fourth year, first semester. Prerequisite, Chemistry 105, 106, or 109, 110.

**112. Photography.** Two credit hours. Mechanical Engineering and Architecture, third year, second semester. Prerequisite, Chemistry, 105, 106, or 109, 110.

**113. Principles of Architectural Composition.** Two credit hours. Architecture, third year, first semester. Concurrent, Architecture 109.

**114. Designing.** Three credit hours. Architecture, fourth year, second semester. Prerequisite, 108.

**115. Designing.** Six credit hours. Architecture, fourth year first semester. Prerequisite Architecture 108.

**116. Professional Practice.** Four credit hours. Architecture, fourth year, second semester. Prerequisite, Architecture 115.

**117. Sanitary Plumbing.** One credit hour. Architecture, fourth year, first semester.

**118. Thesis.** Five credit hours. Architecture, fourth year, second semester.

**119. Masonry.** Two credit hours. Architecture, fourth year first semester. Prerequisite, Architecture 110.

**120. Summer Work.** The equivalent of four weeks of work in an architect's office, or a problem in design, assigned by the department. Between the second and third years.

**121. Summer Work.** The equivalent of four weeks work in an architect's office, or a problem in design, assigned by the department. Between the third and fourth years.

**122. Photography.** Two credit hours. Second semester. Prerequisite, Architecture 111 or 112.

**124. Shades, Shadows and Perspective.** Three credit hours. Architecture, second year, second semester. Prerequisite, Engineering Drawing 107.

## FOR GRADUATES ONLY

For a complete description of the graduate work, the bulletin of the Graduate School should be consulted.

**201-202. Advanced Design.** Three to ten credit hours. The year. Library, conference, and drawing room work. Time to be arranged with the instructor. Prerequisite, the permission of the instructor. This course deals with special and complex problems in architectural design, and is under the supervision of Professor Bradford and Associate Professor Chubb.

**203-204. Research Work.** Three credit hours, The year.

Library and conference work. Time to be arranged with the instructor. Prerequisite, the permission of the instructor. This course deals with problems of Architectural History, and is under the supervision of Professor Bradford.

# ASTRONOMY

(Office, Emerson McMillin Observatory)

PROFESSOR H. C. LORD, ASSOCIATE PROFESSOR MANSON

## EQUIPMENT

The equipment consist of six sextants, two small theodolites, five chronometers, a Riefler standard clock and 2½-inch zenith telescope, by Troughton & Simms; for accurate time or longitude there is provided a 3-inch combined portable transit and zenith telescope by Saegmuller, and chronograph by Warner & Swasey. For refined azimuth determination there is a theodolite by Troughton & Simms, equipped with 12-inch horizontal and vertical circles, reading to single seconds of arc.

Further equipment comprises a 12½-inch equatorial telescope with mounting by Warner & Swasey, objective by Brashear, and a Universal star spectroscope by Brashear; a position micrometer by Warner & Swasey; a 4-inch portable equatorial by Alvan Clark; comparator by Zeiss, and a set of meteorological instruments. A 2-horse power gas engine, dynamo and a large storage battery are also provided.

Ten students can work each clear night under constant supervision of the instructor, the inconvenience of open air observations being reduced to a minimum.

## SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**104. Astronomy, Geodesy and Least Squares.** Three credit hours. Civil Engineering, third year, second semester. Prerequisite, Mathematics 142.

**105.** Continuation of 104. Three credit hours. Civil Engineering, fourth year, first semester.

**Note**—For graduate courses, the bulletin of the Graduate School should be consulted.

## CERAMIC ENGINEERING

(Office, Room 131, Mines Building)

PROFESSORS ORTON AND PURDY,* ASSISTANT PROFESSOR STALEY, MR. HARROP, MR. POTTS

### EQUIPMENT

The Department of Ceramic Engineering occupies the western third of the School of Mines Building. In the basement are a pottery laboratory, a brick machine room, and a room chiefly devoted to the grinding of dry materials. There is also a large store room, and in an attached fireproof wing a kiln room. On the first floor, besides offices and class-rooms, there is a chemical laboratory and a museum of ceramic products. On the second floor are rooms for physical testing and measurement, advanced thesis work, and drawing.

The facilities of the department comprise a chemical laboratory equipped for forty students and especially suited for mineral analysis; a mechanical outfit for the preparation of clays for pottery manufacture, and the production of the ware itself; machinery for grinding and tempering clays; a plant for the manufacture of brick, tiles, pipes, and hollow goods; a kiln house equipped with three downdraft kilns, using solid fuel, and two Caulkins muffle kilns arranged to fire with either oil or gas, and several small furnaces for burning cements, testing refractory materials, melting glass, and making fritts, using compressed air and natural gas; an electric furnace for high temperature work. The lecture room is equipped with a series of wall charts, cases containing a mineral collection and a large number of American and foreign clays, a collection of upwards of five hundred lantern slides illustrating the occurrence, preparation, and manufacture of clays. A ceramic museum containing a small collection of pottery and clay products has been assembled, mostly by donation. A library of the best literature on ceramic technology, containing about four hundred volumes, is open to the students daily from 8 A. M. to 10 P. M.

### SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**101. Ceramic Chemistry.** Five credit hours. Ceramic Engineering and Short Clay-working, second year, first semester. Prerequisite, Chemistry 106 or 110.

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*Resigned, Effective July 1, 1912

Quantitative analysis of limestone and simple minerals.

**102. Ceramic Chemistry**. Three credit hours. Ceramic Engineering, second year, second semester. Prerequisite, Ceramic Engineering 101. Quantitative analysis of clays, fire gases, etc.

**103. Ceramic Manufacture**. Five credit hours. Ceramic Engineering, third year, first semester; Short Clay-working, second year, first semester. Origin, occurrence, constitution, properties and methods of winning ceramic material.

**104.** Continuation of 103. Five credit hours. Ceramic Engineering, third year; Short Clay-working, second year, second semester.

General principles of manufacture of clay wares; theory and practice of drying and burning.

**106. Ceramic Calculations.** Two credit hours. Ceramic Engineering and Short Clay-working, second year, second semester. Prerequisite, Ceramics 101.

Calculations involved in blending of ingredients used in ceramic mixtures; determinations of limits of variation in given series; limits of errors; volume calculations; problems in heat.

**108. Physical and Chemical Measurements of Clays.** Three credit hours. Ceramic Engineering, third year, second semester.

Application of physical chemical laws to fusions of mineral mixtures; determination of melting points; deformation periods; relative viscosity of fused magmas; study of influence of salts on viscosity of slips, etc.

**110. Colors and Glazes.** Two credit hours. Ceramic Engineering, third year, second semester; Short Clay-working, second year, second semester. Prerequisite, Ceramics 101 and 103.

The decoration of clay wares by glazing and coloring. This course deals with decoration from the technological side only, not touching upon the artistic.

**111. Laboratory Work in Ceramics.** Five credit hours. Ceramic Engineering, fourth year, first semester. Prerequisite, Ceramics 104, 108, 110.

Practice in clay testing and measurement of physical properties of clays; the production of bodies made from single clays and of clays with minerals. In each case the bodies are burned and tested.

**112.** Continuation of 111. Five credit hours. Ceramic Engineering, fourth year, second semester. Prerequisite, Ceramics. 111.

The production of slips, engobes, and glazes, and the study of the methods of coloring.

**113. Ceramic Designing**. Two credit hours. Ceramic Engineering, fourth year, first semester. Prerequisite, Ceramics 104.

Designing, estimating cost of and writing specifications for kilns and dryers.

**114.** Continuation of 113. Three credit hours. Ceramic Engineering, fourth year, second semester. Prerequisite, Ceramics 113.

The work started in Ceramics 113 is extended to the design and equipment of clay-working plants.

**115. Laboratory Work in Ceramics.** Two credit hours. Short Clay-working, second year, first semester. Concurrent, Ceramics 103.

Testing of clays and minerals employed in clay manufacture and in blending of same for ceramic purposes.

**116. Thesis.** Four credit hours. Ceramic Engineering, fourth year, second semester.

**118. Cement Manufacture.** Five credit hours. Alternative with Ceramics 112. Ceramic Engineering, fourth year, second semester. Prerequisites, 102 and 104.

The theory of hydraulicity, the compounding, manufacture, and testing of natural and Portland cements and other hydraulics.

**120. Laboratory Drill in Ceramic Calculations.** One credit hour. Short Clay-working, second year, second semester.

This course is supplementary to Ceramics 106 for Short Course Students.

**122. Dryer and Kiln Design.** Two credit hours. Short Clay-working, second year, second semester. Concurrent with Ceramics 106.

A graphic study of dryer and kiln design.

**126. Laboratory Work in Ceramics.** Five credit hours. Short Clay-working, second year, second semester. Prerequisite, Ceramics 115.

The preparation of slips, engobes and glazes, and the study of the methods of coloring.

## FOR GRADUATES ONLY

For a complete description of the graduate work, the bulletin of the Graduate School should be consulted.

**201-202. Research Work.** Three to ten credit hours. The year. Library, conference and laboratory work. Time arranged with the Instructor. Prerequisite, the permission of the instructor in charge.

Research work in analytical and physical chemistry of silicates is conducted under the supervision of Assistant Professor Staley; in Mineralogy and geology of clay deposits and testing of clays and clay products, under Professor Orton; in the production and constitution of Ceramic bodies and cements, under Professor Purdy; in the Engineering and designing of structures for Ceramic Industries, under Mr. Harrop.

# CHEMISTRY

(Office, Chemistry Hall)

PROFESSOR MCPHERSON, EMERITUS PROFESSOR NORTON, PROFESSORS HENDERSON, FOULK AND EVANS, ASSOCIATE PROFESSOR WITHROW, DR. WILKINSON, MR. KELLOGG, AND DEPARTMENT ASSISTANTS

## EQUIPMENT

The Department of Chemistry occupies the greater part of Chemistry Hall. In the basement are two laboratories, each accommodating 600 students in elementary chemistry. There are also laboratories for industrial chemistry, for organic combustion work and a repair shop. On the first floor are the main office of the department, a large laboratory for organic chemistry accommodating eighty students, a smaller one for research work, a lecture room, a library and a main store room where all the laboratory and office supplies of the University are kept in stock.

On the second floor is the main lecture room, having a seating capacity of 300, and equipped with lantern, specimens, etc., for demonstration work. On this floor are laboratories for the following lines of work: Physical chemistry, general analytical work, advanced inorganic chemistry, and the chemical investigation of water. There are also three small private laboratories, the balance room, a small lecture room, and the electrical room, containing the storage batteries, a mercury rectifier and switchboard. On the upper floor are three recitation rooms. The apparatus for ventilating the hoods and the large still for furnishing distilled water are also located here.

The department is well equipped with all the necessary apparatus for carrying on not only the elementary work in chemistry, but advanced and research work as well. The general chemical apparatus is loaned to the student, and no charge is made if it is returned in good order. The laboratories are supplied with all the modern conveniences, and each student has his own locker in which he keeps his apparatus. The storage battery room is connected with the various laboratories so that the current can be utilized wherever needed.

## SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**101. Elementary Chemistry**. Four credit hours. First semester, one lecture, one quiz, six hours laboratory weekly. Short Mining, second year. Short Clayworking, first year.

A general introductory course on the chemistry of the non-metals. It is distinctly elementary in character and is arranged for students in short courses only. No credit is allowed for it in the regular four year courses. Students taking this course should follow with course 102, second semester.

**102. Elementary Chemistry and Qualitative Analysis.** Continuation of Chemistry 101. Short courses. Second semester.

A general introductory course on the chemistry of the metals. The laboratory work deals with the elementary principles of qualitative analysis. The course is arranged for students in short courses only. No credit is allowed for it in the regular four year courses.

**105. Elementary Chemistry**. Four credit hours. First semester. One lecture, one quiz, and six hours laboratory weekly. Taken by first year students in all four year courses who have not presented chemistry for entrance requirement. A general course in the chemistry of non-metals.

**106. Elementary Chemistry and Qualitative Analysis.** A continuation of Chemistry 105. Four credit hours. Second semester.

A general course in the Chemistry of the metals. The laboratory work accompanying is a general introductory course in qualitative analysis.

**109. General Chemistry.** Four credit hours. First semester. One lecture, one quiz, and six hours laboratory weekly. Taken by first year students in all four year courses who have presented Chemistry as an entrance requirement. A general course on the chemistry of non-metals.

**110. General Chemistry and Qualitative Analysis.** A continuation of Chemistry 109. Four credit hours. Second semester.

A general course in the chemistry of the metals. It is more advanced than Chemistry 106. The laboratory work is a general course in qualitative analysis.

**113. Advanced General Chemistry.** Two credit hours. Two lectures weekly. Chemical Engineering, second year, first semester. Prerequisite, Chemistry 106 or 110.

A course on the fundamental topics of Advanced General Chemistry.

**114. Advanced General Chemistry.** A continuation of Chemistry 113. Two credit hours. Chemical Engineering, second year, second semester.

**117. Qualitative Analysis.** Three credit hours. First semester. One lecture and six hours laboratory weekly. Time to be arranged. Prerequisite, an acceptable course in general chemistry.

**119. Quantitative Analysis.** (a) Three credit hours. One lecture and six hours laboratory weekly. Mine Engineering, second year, first semester. (b) Four credit hours. One lecture and nine hours laboratory weekly. Chemical Engineering, second year, first semester. Prerequisite, Chemistry 106 or 110.

The elementary principles of gravimetric and volumetric analysis.

**120. Quantitative Analysis.** Four credit hours. One lecture and nine hours laboratory weekly. Chemical Engineering, second year, second semester. Prerequisite, Chemistry 119. A continuation of Chemistry 119 with typical analytical methods in gravimetric and volumetric analysis. This course must be accompanied by Chemistry 124. It is desirable that it be accompanied by Chemistry 114.

**124. Chemical Problems.** One credit hour. Chemical Engineering, second year, second semester.

Extended practice in the solution of problems pertaining to gravimetric and volumetric analysis. This course is arranged to accompany Chemistry 120.

**136. The Reading of Chemical Literature.** Two credit hours. Chemical Engineering, elective, third year, second semester. Prerequisite, one year of German.

The object of this course is to afford practice in the rapid reading of German chemical literature, the selections being made with special reference to the technical terms of the science.

**140. Thesis.** Four credit hours. Chemical Engineering, fourth year, second semester.

**151. Organic Chemistry.** Two credit hours. Two lectures weekly. Chemical Engineering, third year, first semester. Prerequisite, Chemistry 114 and 120.

General course in Organic Chemistry.

**152.** Continuation of 151. Two credit hours. Two lectures weekly. Chemical Engineering, third year, second semester. Prerequisite, Chemistry 151.

**153. Organic Chemistry.** Two or three credit hours. Six or nine hours laboratory weekly. Chemical Engineering, third year, first semester. Must be accompanied or preceded by Chemistry 151.

A general course in the preparation of typical organic compounds.

**154.** Continuation of 153. Two or three credit hours. Six or nine hours laboratory weekly. Chemical Engineering, elective third year, second semester. Must be preceded or accompanied by Chemistry 152.

**157. Physical Chemistry.** Three credit hours. Three lectures weekly. Chemical Engineering, fourth year, first semester, and Ceramic Engineering, third year, first semester. Prerequisite, Chemistry 114, 120, and 152.

This is a general course in Physical Chemistry.

**158. Physical Chemistry.** Three credit hours. Three lectures weekly. Chemical Engineering, fourth year, second semester. Ceramic Engineering, third year, second semester. Prerequisite, Chemistry 157.

**162. Physical Chemistry.** Two or three credit hours. Six or nine hours laboratory weekly. Elective, second semester.

**167 Special Methods of Analysis.** Three to five credit hours. First semester. One lecture and six to twelve hours laboratory work weekly. Chemical Engineering, elective, third year. Prerequisite Chemistry 119-120.

Selections may be made from gas analysis, microchemical analysis and spectrum analysis. Time to be arranged.

**168. Qualitative Analysis.** Advanced course. Three to five credit hours. One lecture, six to twelve hours laboratory weekly. Chemical Engineering, elective third year, second semester, Prerequisite, Chemistry 120, or equivalent.

Extended work in general qualitative analysis including the more important of the rare elements.

**176. Sanitary Analysis.** Three credit hours. Two lectures and three hours laboratory weekly. Chemical Engineering, elective third year, second semester. Prerequisite, Chemistry, 120, or equivalent.

A study of the methods of sanitary water analysis and interpretation of results.

**177. Industrial Chemistry.** Two credit hours. First semester. Two lectures weekly. Prerequisite, Chemistry 113-114 and 153-154.

A general course in the principles underlying the application of chemistry in the industries.

**178. Industrial Chemistry.** One credit hour. Second semester. One lecture weekly. Prerequisite, Chemistry 177.

**182. Industrial Inspection Trip.** A four to six day excursion at a suitable time in connection with Course 177-178 for the inspection of industrial chemical processes in actual operation. The entire expense varies from $15 to $30. A satisfactory report on the work inspected is required.

**184. Written Reports.** A course of assigned reading upon some industrial chemical process and a written report on same. This is a substitute for Chemistry 182, but the substitution is only allowed upon presentation of reasons satisfactory to the instructor in charge.

**185. Industrial Chemistry.** Two credit hours. One conference, five hours laboratory work weekly. Prerequisite, Chemistry 119-120. Prerequisite or Concurrent, 177. A course in industrial chemical research.

**186. Industrial Chemistry.** Three credit hours. One conference, eight hours laboratory work weekly. Prerequisite, Chemistry 119-120. Prerequisite or Concurrent, Chemistry 177-178. A course of industrial chemical research and technical analysis.

**187. Inorganic Preparations.** Two or three credit hours. Six or nine hours laboratory weekly. Chemical Engineering, elective third year, first semester. Prerequisite, Chemistry 114. A course in the preparation of a limited number of compounds chosen so as to give practice in the different kinds of manipulation involved in the preparation of inorganic compounds.

**188.** Repetition of 187.

**191. Rare Elements.** Two credit hours. Two lectures weekly. Elective, second semester. Given biennially. Not given 1911-12. Prerequisite, Chemistry 114 and 120.

A general course on the chemistry of the rare elements, including a discussion of their increasing economic importance.

**194. Applied Electro-Chemistry.** Two credit hours. Two lectures weekly. Elective, second semester. Prerequisite, Chemistry 158, except by the special permission of the instructor.

A descriptive course covering the application of the Electric Current in chemical industries.

### Graduate Work

For full information relative to the graduate work offered by this Department, the bulletin of the Graduate School should be consulted.

**201-202. Physical Chemistry.** Three credit hours. The year, or may be elected either semester separately. Nine hours laboratory work weekly. Prerequisite, Chemistry 157-158. Professor Henderson.

A general course on physico-chemical measurements.

**205-206. Organic Chemistry.** Advanced course. Three to five credit hours. The year. Library, conference and laboratory work. Prerequisite, Chemistry 153-154. Professor McPherson.

Special attention is given to the preparation of organic compounds with reference to yield and purity of products. Extended practice is also given in the quantitative determination of the elements present in organic compounds.

**221. Chemical Thermodynamics.** Two credit hours. First semester. Two lectures weekly. Given in 1913-14, and biennially thereafter. Prerequisite, permission of the instructor in charge Professor Henderson.

**224. Electro Chemistry.** Two credit hours. Second semester. Two lectures weekly. Given in 1913-14 and biennially thereafter. Prerequisite, permission of the instructor in charge. Professor Henderson.

**227. Analytical Chemistry.** Two credit hours. First semester. Two lectures weekly. Prerequisite, permission of the instructor. Professor Foulk.

**231-232. Chemical Seminar.** One credit hour. The year.

All those engaged in giving instruction in the department, together with the fellows and graduate students, meet for an extended discussion of chemical problems of general interest.

**235-236. Research Work.** Five to ten credit hours. The year. Library, conference and laboratory work. Time arranged with instructor. Prerequisite, permission of the instructor in charge. Research work in organic chemistry is conducted under the supervision of Professor McPherson and Professor Evans; in physical and general chemistry under Professor Henderson; in analytical chemistry under Professor Foulk and Dr. Wilkinson; in industrial and electro-chemistry under Associate Professor Withrow.

# CIVIL ENGINEERING

(Office, Room 33, Brown Hall)

PROFESSORS SHERMAN, ENO AND MORRIS, ASSISTANT PROFESSORS SCHLAFLY, AND CHAMBERLIN, MR. STERTZBACH, MR. WAID, MR. WARD, MR. MCCALL.

## EQUIPMENT

The department occupies the eastern half of Brown Hall. For drafting, three spacious and well-lighted drawing rooms are provided for the work of the second, third, and fourth-year students, respectively. In each room is a collection of working drawings, prints, maps, etc., gathered from practising engineers, and arranged in suitable file cases for ready consultation by the student. A large blue-print room on the ground floor is equipped with electrical blue-print apparatus, in addition to the ordinary sunlight frames.

For field work, the instruments are one theodolite, eighteen transits fitted for various kinds of surveying, thirteen leveling instruments, plane table, solar compass, solar attachments, high-grade aneroid barometers, drainage levels, surveying camera, rods, chains, tapes, handlevels, etc. Two current meters with accessories, and a rating course 175 feet long in the rear of the building furnish facilities for carrying on hydrographic work.

The cement-testing laboratory is fitted with necessary appliances for making the ordinary tests. It contains Fairbanks and Riehle tensile testing machines, briquette molds, sieves, apparatus for making hot tests, etc., and a machine for testing plain and reinforced concrete beams.

The department also owns a complete outfit for carrying on the work of summer surveying in camp.

## SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**101. Land Surveying.** Four credit hours. Four recitations weekly. Civil Engineering, second year, first semester. Prerequisite, Mathematics 132, Engineering Drawing 102.

Care and use of instruments. Farm, City, and Hydrographic Surveying.

**101a. Field Practise.** One credit hour. Three hours per week in field. Civil Engineering, second year, first semester. Prerequisite, concurrent Civil Engineering 101. Field exercises in use of instruments, and surveying.

**102. Railroad Surveying.** Three credit hours. Three recitations per week. Civil Engineering, second year, second semester. Prerequisite Civil Engineering 101 and 101a. Simple, compound, and transition curves, frogs, switches, and earthwork.

**102a. Field Practise.** One credit hour. Three hours per week in field. Civil Engineering, second year, second semester. Prerequisite, concurrent Civil Engineering 102. Field practise in laying out curves, frogs, switches, and earthwork.

**103. Topographic Drawing.** Two credit hours, six hours per week in drafting room. Civil Engineering, second year, first semester. Prerequisite, Engineering Drawing 102. Exercises in black ink and color topographic drawing.

**104. Summer Surveying Camp.** Civil Engineering at close of second year. Prerequisite, Civil Engineering 101a, and 102a.

Four weeks of six days per week of ten hours per day, from the middle of June to the middle of July.

**105. Topographic Surveying.** Three credit hours. Nine hours per week in field or drawing room. Civil Engineering, third year, first semester. Prerequisite, Civil Engineering 101, 102, and 104.

Field and office work in four or five kinds of topographic surveying.

**106. Roads and Streets.** Three credit hours. Three recitations weekly. Civil Engineering, third year, second semester. Prerequisite, Civil Engineering 102, and 104.

**107. Stereotomy.** Three credit hours. Recitations, lectures, and drawing. Civil Engineeing, third year, first semester. Prerequisite, Engineering Drawing 106.

**108. Timber Construction.** Three credit hours. Lectures and drawing. Civil Engineering, third year, second semester. Prerequisite, Engineering Drawing 105, Concurrent Mechanics 102.

**109. Sanitary Engineering.** Two credit hours. Two recitations per week. Civil Engineering, third year, first semester. Prerequisite Civil Engineering 102, and 104.

**110. Stresses in Structures.** Four credit hours. Four hour recitations weekly. Civil Engineering, third year, second semester· Concurrent Mechanics 102.

**111. Summer Surveying Camp.** Civil Engineering at close of third year. Prerequisite, Civil Engineering 104, and 105.

Four weeks of six days per week of ten hours per day, from the middle of June to the middle of July.

**112. Railway Location.** Four credit hours. Four recitations per week. Optional with Civil Engineering 114. Civil Engineering, fourth year, second semester. Prerequisite, Civil Engineering 102 and 111, and Mechanics 102.

**113. Bridge Designing.** Four credit hours. Four recitations per week. Civil Engineering, fourth year, first semester. Prerequisite, Civil Engineering 110.

**114. Advanced Bridges.** Four credit hours. Four recitations per week. Optional with Civil Engineering 112. Civil Engineering, fourth year, second semester. Prerequisite, Civil Engineering 113.

**115. Masonry Construction.** Three credit hours. Three recitations weekly. Civil Engineering, fourth year, first semester. Prerequisite, Civil Engineering 111, Mechanics 102.

**116. Masonry Stuctures.** Three credit hours. Three recitations, lecture or drawing periods per week. Civil Engineering, fourth year second semester. Prerequisite, Civil Engineering 115.

**117. Water Supply**. Three credit hours. Three recitations per week. Civil Engineering, fourth year, first semester. Prerequisite, Civil Engineering 111, Mechanics 102.

**117a,** Repetition of 117, in the second semester.

**118. Cement and Concrete.** Three credit hours. Architecture, Ceramic, and Civil Engineering, fourth year, second semester. Prerequisite, Mechanics 102, or 104.

**118a,** Repetition of 118, in the second semester.

**119. Thesis.** One credit hour. Civil Engineering, fourth year, first semester. Prerequisite, Civil Engineering 110, and 111.

**120. Contracts and Specifications.** Two credit hours. Two recitations or lectures weekly. Civil Engineering, fourth year, second semester. Prerequisite, Civil Engineering 106, 109, and 115.

**121. Surveying and Topographic Drawing.** Six credit hours. First semester. Prerequisite, Mathematics 114 or 132, and Engineering Drawing 101.

The work will be divided into lectures, recitations, field work, computing, and drawing in such manner as the schedule and weather will permit.

**122. Thesis.** Four credit hours. Civil Engineering, fourth year second semester. Prerequisite, Civil Engineering 119.

**123. Trusses.** Lectures, recitations, and drawing. Three credihours. Ceramic, and Mechanical Engineering, fourth year, first semester. Drawing the last three or four weeks. Prerequisite, Mechanics 102, or 104.

**124.** Repetition of 123. Architecture and Mine Engineering third year, second semester. Concurrent, Mechanics 102, or 104.

**125. Tall Buildings.** Three credit hours. Three lectures weekly. Architecture, fourth year, first semester. Prerequisite, Civil Engineering 124.

**126. Timber and Masonry.** Two credit hours. Two lectures or recitations weekly. Mechanical Engineering, third year, second semester. Concurrent Mechanics 102.

**128. Plane Surveying.** Two credit hours. One lecture and one field exercise of three hours per week. Architecture, fourth year, second semester, and Mechanical Engineering, second year, second semester. Prerequisite, Engineering Drawing 102, Mathematics 132.

## FOR GRADUATES ONLY

For a complete description of the graduate work, the bulletin of the Graduate School should be consulted.

**201-202. Investigation and Design.** Three to ten credit hours The year. Library, conference, and laboratory work. Time arranged with the instructor. Prerequisite, the permission of the instructor in charge. Work in Railroad and Topographic Engineering is conducted under the supervision of Professor Sherman; in Bridge and Structural Engineering under Professor Morris; in Municipal and Sanitary Engineering under Professor Eno; in Stereotomy and Masonry Construction under Assistant Professors Schlafly and Chamberlin.

**203-204. Research Work.** Three to ten credit hours. The year. Library, conference, and laboratory work. Time arranged with the instructor. Prerequisite, the permission of the instructor. For division of the field and personnel, see Course 201-202.

# ELECTRICAL ENGINEERING

(Office, Room 171, Robinson Laboratory)

PROFESSORS CALDWELL AND HUNT, MR. HEITMANN, MR. SHEPARDSON, MR. MAINLAND.

## EQUIPMENT

This department is located in the north end of the Robinson Laboratory. It has one large dynamo laboratory, 90 x 112 feet, and seventeen smaller rooms. There are also two long balconies used for drafting and computation.

Among the smaller rooms the following may be especially noted: The calibration room is well and conveniently fitted up with standards. These are kept accurate by frequent comparison at the National Bureau of Standards and are at the service of the electrical industries of the State.

Two telephone laboratories are separated by a sound-proof partition. They are well equipped with apparatus of different makes, including a set of Western Electric switchboard apparatus. There is also an artificial 100-mile line, comparison apparatus, and a 5-station 2-wire set loaned by the Automatic Electric Company, and used as an intercommunicating set for the department. The wireless telegraph laboratory has a two kilowatt sending station and good receiving apparatus.

The illumination laboratory is fitted for working with light or dark walls; there is a good photometric outfit and an illuminometer. The cable and iron testing laboratory is used for such work as requires galvanometers and other delicate apparatus. The battery room contains a 140-volt and an 8-volt high current battery, with end-cell switching arrangements, etc. There are two small shops fitted up for the construction and repair of apparatus by the department machinist. The necessary recitation rooms, offices, etc., are provided, and a museum with a collection of material illustrating applied electricity.

On the main floor is a space screened off for high potential work, where a 250,000-volt 50-kilowatt transformer forms a part of the equipment. Preparation has been made for apparatus suitable for running and testing in the laboratory a complete interurban car. The dynamo equipment of seventy-five generators and motors, both alternating and direct current, aggregates over 800 horsepower capacity, and includes all important commercial types. A liberal equipment of measuring instruments of various kinds is available, including potentiometer, oscillograph, tachometers, frequency meters, etc.

## SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**101. Electrical Engineering.** Five credit hours. Three lectures and one four-hour laboratory period weekly. Chemical Engineering, and Mechanical Engineering, fourth year, first semester. Prerequisite, Physics 112, or Physics 114.

Lectures and laboratory work on direct and alternating current circuits, dynamo machinery, transformers, accumulators, and their applications.

**103. Electrical Engineering.** Three credit hours. Two lectures and one three-hour laboratory period weekly. Civil Engineering, third year, Mine Engineering, fourth year, first semester. Prerequisite, Physics 112, or 114.

Lectures and laboratory work on direct current machinery, circuits, and transmission.

**104. Direct Current Machinery.** Five credit hours. Three lectures and one four-hour laboratory period weekly. Electrical Engineering, third year, second semester. Prerequisites, Physics 135, Mathematics 142 and Mechanics 101.

Generators and motors, their theory, construction, and operation. Lectures, recitations, problems, and laboratory.

**106. Applications of Electricity.** Three hours for one-half semester. Three lectures per week. Electrical Engineering, third year, second semester . Prerequisites, Physics 135, and Mathematics 142.

A brief treatment of the uses of electricity, illumination, railways, mining, etc.

**108. Alternating Current Circuits and Machinery.** Three hours, for one-half semester. Electrical Engineering, third year, second half of second semester. Prerequisites, Mathematics 142, Physics 135, Mechanics, 101, concurrent, Electrical Engineering 104.

General principles, circuits, generators, and transformers,

**109. Alternating Current Machinery.** A continuation of Electrical Engineering 108. Three credit hours. Three lectures weekly. Electrical Engineering, fourth year, first semester. Prerequisite, Electrical Engineering 108, and concurrent, Electrical Engineering 111.

Transformers, synchronous motors, induction motors, etc.

**111. Alternating Current Laboratory.** Three credit hours. Electrical Engineering, fourth year, first semester. Prerequisite, Electrical Engineering 108, Concurrent Electrical Engineering 109.

Alternating current, railway and telephone apparatus, accumulators.

**112. Advanced Alternating Current Laboratory.** Three credit hours. Electrical Engineering, fourth year, second semester. Prerequisite, Electrical Engineering 109 and 111.

**113. Electrical Railways.** Two credit hours. Electrical Engineering, fourth year, first semester. Alternative with Electrical Engineering 115, 117, 119. Prerequisite, Electrical Engineering 104, Concurrent Electrical Engineering 109. Systems, apparatus, and operation.

**115. Telephony.** Two credit hours. Electrical Engineering fourth year, first semester. Alternative with Electrical Engineering 113, 117, and 119. Prerequisites, Electrical Engineering 104 and 108-

Methods of operation, simple circuits and apparatus, elements of transmission theory.

**117. Electric Illumination.** Two credit hours. Electrical Engineering, fourth year, first semester. Alternative with Electrical Engineering 113, 115, and 119. Prerequisites, Electrical Engineering 104 and 108,

Principles of illumination, electric lamps, wiring plans, etc.

**119. Wireless Telegraphy.** Two credit hours. Electrical Engineering, fourth year, first semester. Alternative with Electrical Engineering 113, 115, 117. Prerequisites, Electrical Engineering 104 and 108.

Elementary theory, production, transmission, and detection of damped and undamped oscillations.

**121. Electrical Design.** Three credit hours. Two lectures and one four-hour drawing period weekly. Electrical Engineering, fourth year, first semester. Prerequisite, Electrical Engineering 104.

Direct current dynamos, transformers, etc.

**122. Electrical Design.** Two credit hours. A continuation of Electrical Engineering 121. One lecture and one three-hour drawing period weekly. Electrical Engineering, fourth year, second semester. Elective.

Alternating current apparatus.

**124. Electrical Transmission and Distribution.** Two credit hours. Two lectures weekly. Electrical Engineering, fourth year, second semester. Prerequisite, Electrical Engineering 109.

Systems, apparatus, and operation.

**125. Special Reading and Laboratory.** Credit hours to be arranged. Elective for fourth year Electrical Engineering and graduate students with consent of the instructor in charge, First semester. Prerequisites, Electrical Engineering, 104 and 108.

**126. Special Reading and Laboratory.** A continuation of Electrical Engineering 125. Second semester.

**127. Thesis.** One credit hour. Electrical Engineering, fourth year, first semester. Prerequisites, Electrical Engineering 104 and 108.

**128. Thesis.** Five credit hours. Electrical Engineering, fourth year, second semester.

**130. Inspection Trip to the East.** Given only in the even years. The seventh week before Commencement. Electrical Engineering, third or fouth year.

Includes Pittsburg, Buffalo, Niagara, and Cleveland. The entire expense need not exceed $32. A satisfactory written report is required.

**132. Inspection Trip West.** Given only in the odd years. The seventh week before Commencement. Electrical Engineering, third or fourth year.

Includes Chicago, Milwaukee, and Gary. The entire expense need not exceed $32. A satisfactory written report is required.

**134. Reading Course.** Electrical Engineering, third or fourth years. This may be taken as a substitute for Electrical Engineering 130 on presentation of reasons satisfactory to the head of the department.

Assigned reading on processes of manufacture and power plants.

**136. Reading Course.** Electrical Engineering, third or fourth years. This may be taken as a substitute for Electrical Engineering 132 on presentation of reasons satisfactory to the head of the department.

## FOR GRADUATES ONLY

For a complete description of the graduate work, the bulletin of the Graduate School should be consulted.

**201-202. Advanced Alternating Current Machinery.** Two credit hours. The year. Professor Caldwell.

An advanced course in the theory of alternating currents and alternating current apparatus.

**203-204. Transient Electrical Phenomena.** Two credit hours. The year. Professor Hunt.

A course in the theory of the transient phenomena occuring in electrical machinery and transmission lines.

**205-206. Advanced Alternating Current Dynamo Laboratory.** Two credit hours. The year. Professor Caldwell and Mr. Heitmann.

An advanced laboratory study of alternating current apparatus.

**207-208. Research Work.** Three to five credit hours. The year. Time to be arranged with the instructor. Prerequisite, permission of the instructor in charge. Library, conference, and laboratory work.

Research work in advanced alternating currents is given under the supervision of Professor Caldwell and Mr. Heitmann; in dynamo design, under Professor Hunt; in telephony, under Professor Hunt; in illumination, under Professor Caldwell; in wireless telegraphy, under Mr. Heitmann.

## ENGINEERING DRAWING

(Office, Room 42, Brown Hall)

PROFESSOR FRENCH, ASSISTANT PROFESSOR MEIKLEJOHN, MR. WILLIAMS, MR. HARPER, MR. SHEETS, MR. IVES, MR. TURNBULL, MR. GILBERT. MR. NORRIS

### EQUIPMENT

For Engineering Drawing there are four large, well lighted drawing rooms in Brown Hall and two in Hayes Hall equipped with individual drawing tables and lockers, and two lecture rooms, with electric projection lantern. A blue print room is provided with electric light printing machine and sun frames. There is a good set of models illustrating intersections and warped surfaces, and a large collection of machine parts, small machines, patterns, core boxes and models, with a case of machinist's tools such as calipers, scales, surface gauges, etc., for use in machine sketching.

The department has an equipment of many special instruments for illustration and use, such as Universal drafting machines, Kelsey drafting rig, suspended pantograph, Ockerson machine, different types of section liners, lineads, curves, proportional dividers, protractors, special pens, etc.

Hand books, data sheets, catalogues and typical examples of shop drawings are available for student use.

The library contains an unusually extensive collection of books on descriptive geometry, machine design, graphics, perspective and lettering.

## SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**101. Elementary Mechanical Drawing.** Two credit hours. All four-year courses, first year, first semester.

Practise in the use of drawing instruments, elementary projections.

**102. Mechanical Drawing.** Three credit hours. All four-year courses, first year, second semester. Prerequisite, Drawing 101. Lettering, orthographic, isometric, and oblique projections.

**103. Descriptive Geometry.** Three credit hours. Two recitations, one drawing period weekly. Ceramic, chemical, electrical, mechanical and mining engineering, second year, first semester. Prerequisite, Drawing 102, or 114.

**104. Machine Sketching.** Three credit hours. One lecture, two drawing periods weekly. Ceramic, chemical, mechanical and mine engineering, second year, second semester. Prerequisite, Drawing 103.

**105. Descriptive Geometry**. Three credit hours. Two lectures, one drawing period weekly. Civil Engineering second year, first semester. Prerequisite, Drawing 102.

**106. Advanced Descriptive Geometry**. Three credit hours. Two lectures, one drawing period weekly. Civil Engineering, second year, second semester. Prerequisite, Drawing 105.

**107. Descriptive Geometry**. Three credit hours. Two recitations, one drawing period weekly. Architecture, second year, first semester. Prerequisite, Drawing 102.

**110. Technical Sketching.** Two credit hours, Electrical Engineering, second year, second semester. Prerequisite, Drawing 103.

**111. Technical Drawing.** Two credit hours. Mechanical and Electrical Engineering, third year, first semester. Prerequisite, Drawing 104, or 110.

**113. Free-hand Drawing and Lettering.** Four credit hours. Short courses in Clay Working and Industrial Arts, first year, first semester. Short mining course, second year, first semester.

**114. Mechanical Drawing.** Three credit hours. Short courses in Clay Working, Industrial Arts, first year, second semester. Short mining,second year, second semester. Prerequisite, Drawing 113.

**115. Charcoal from Architectural Ornament.** Two credit hours. Architecture, second year, first semester.

**116. Pen Drawing.** Two credit hours. Architecture, second year, second semester.

**117. Water Color.** Three credit hours. Architecture, third year, first semester.

**118. Charcoal Drawing from the Antique.** Three credit hours. Architecture, third year, second semester. Prerequisite, Drawing 115.

**119. Clay Modeling.** Two credit hours. Architecture, fourth year, first semester. Prerequisite, Drawing 115.

**121. Technical Drawing.** Two credit hours. Designing of chemical plants and machinery. Chemical Engineering, third year first semester. Prerequisite, Drawing 104.

**122. Technical Drawing.** Two credit hours. Continuation of 121. Chemical Engineering, third year, second semester.

## ENGLISH

(Office, English Building)

PROFESSORS DENNEY, MCKNIGHT, ASSOCIATE PROFESSOR GRAVES, ASSISTANT PROFESSORS DUNCAN, COOPER, HARRINGTON, BECK.

**101. Paragraph Writing: Description and Narration.** Two credit hours. First semester. (Course 101 will be repeated in the second semester as course 102 for the benefit of those who fail, the class meeting Saturdays at 9 a. m.)

**104. Paragraph Writing: Exposition and Argumentation.** Two credit hours. Second semester. Prerequisite, course 101. Same hours as for course 101. (Course 104 is also offered in the Summer Session.)

# GEOLOGY

(Office, Room 1, Orton Hall)

PROFESSORS PROSSER AND BOWNOCKER, ASSISTANT PROFESSOR HILLS, MR. MORSE.

## EQUIPMENT

This department is located in Orton Hall and is noted for its fine museum of geological material. As the collections of the State Geological Survey are permanently located here, the material illustrative of Ohio formations is particularly complete. It is interesting in this connection to know that in the construction of the building a great variety of material contributed from various quarries of Ohio was used. Thus the building itself forms an important part of the geological collections. Good opportunities are provided for the work in the lithological, stratigraphical, and physiographic laboratories.

## SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**162. Elementary Physiography.** Four credit hours. Short mining, first year, second semester.

The topographic features of the earth's surface and the agencies producing them. The atmosphere; the ocean; rivers. Recitations, lectures, map work, and field work.

**164. Elementary Geology.** Three credit hours. Short mining, second year, second semester.

Lithological, dynamical, structural, and historical geology. Recitations, lectures and laboratory work.

**165. General Geology**. Three credit hours. Mine Engineering, third year, first semester.

Structural, dynamical, and historical geology. The lectures are illustrated by maps, specimens, and lantern views. The common rock-forming minerals and rocks are studied in the laboratory. The first half of the semester, field trips Friday afternoon or Saturday morning will alternate with laboratory periods.

**166. Petrography**. Two credit hours. Mine Engineering, third year, second semester.

A study of hand specimens of igneous, metamorphic, and sedimentary rocks, lectures and laboratory work.

**167. Economic Geology.** Three credit hours. Mine Engineering, fourth year, first semester. Prerequisite, Geology 165-166.

The nature and origin of ores; their modes of occurrence and distribution. The non-metals, coal, oil, gas, clay, lime, cement, and building stones. In the discussion of the non-metals emphasis will be laid on the products of Ohio.

**168. General Geology.** Three credit hours. Ceramic Engineering, fourth year, Civil Engineering second year, second semester.

Structural, dynamical, and historical geology. The lectures are illustrated by maps, specimens, and lantern views. The common rock-forming minerals and rocks are studied in the laboratory. The last half of the semester, field trips Friday afternoon or Saturday morning will alternate with laboratory periods.

### FOR GRADUATES ONLY

For a complete description of the graduate work, the bulletin of the Graduate School should be consulted.

**201-202. Advanced Historical Geology.** Three to five credit hours. The year. Time to be arranged. Laboratory open afternoons, 1 to 4. Prerequisite, Geology 103-104, 105 and 107-108.

Advanced work in paleontology and stratigraphical geology. Field work to be arranged with individual students and it is recommended that a part of it be done during the summer vacation under the direction of the instructor in charge.

**203-204. Research Work.** Three to five credit hours. The year. Prerequisite, preceding courses in inorganic or historical geology. Field, laboratory, and library study is offered along three lines. Outline of work and time will be arranged with individual students. (a) STRATIGRAPHY AND PALEONTOLOGY. The investigation of some field problem in stratigraphy with laboratory and library study or of some special subject in paleontology. Professor PROSSER. (b) ECONOMIC GEOLOGY. The investigation of some field problem in petroleum, natural gas, coal, or salt. Professor BOWNOCKER.

## GERMAN

(Offices, Rooms 317 and 318, University Hall)

PROFESSOR EVANS, ASSOCIATE PROFESSOR EISENLOHR, ASSISTANT PROFESSORS THOMAS, BARROWS, AND LEWISOHN, DR. BUSEY.

**101-102. Elementary German.** Four credit hours. The year. Open to students in any four-year course who enter with a language other than German.

The essentials of grammar, the first semester.

Reading of easy narrative, grammatical drill, second semester.

**103. Intermediate German.** Four credit hours. Prerequisite, German 102, or two units entrance credit in German. Not open to students who enter with four units entrance credit in German.

Reading of narrative prose, with topical review of grammar. One hour Prose Composition weekly.

**106. Science Reading.** Four credit hours. Second semester.

This course is for engineering students; a continuation of courses 103 and 107.

Rapid reading of German technical literature. Drill on sentence structure and word formation. The object of the course is to put students in the way of reading technical works and current technical literature.

**107. Advanced German.** Four credit hours. Open to first year students who enter with four units credit in German.

## INDUSTRIAL ARTS AND SHOPWORK

(Office, Room 2, Hayes Hall)

PROFESSOR SANBORN, ASSOCIATE PROFESSOR KNIGHT, MR. CROWE, MR. CASE, MR. BEEM, MR. DENMAN, MR. FOUST.

## EQUIPMENT

The carpenter and pattern shops are fitted with well designed benches, each containing a complete set of the necessary carpenter tools. There are also wood-turning lathes including an eight-foot patternmaker's lathe. Among the power tools are planers of different kinds, and circular, scroll, and band saws. In the forge shop are the usual forges and anvils with the accompanying hand tools, and a number of special tools. Among these are a special gas furnace, foot-power hammer, drill, and a combined punch, shear, and bar cutter. The foundry has a twenty-four-inch Colliau cupola, brass furnaces and a core oven. The machine shop contains the benches and tools for vise work and a good equipment of lathes of various types, including a monitor turret lathe, planers, shapers, milling machines, grinding machines, and arbor presses. There is a good equipment of small tools, including a great variety of special ones.

## SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**101. Tools and Machines.** Three credit hours. Three recitations weekly. Short Industrial Arts, second year, first semester. Prerequisite, Mathematics 114 or 132. Concurrent, Physics 101.

Principles underlying the construction and operation of machines with a special study of machine tools.

**102.** Continuation of 101. Three credit hours. Three recitations weekly. Short Industrial Arts, second year, second semester.

**103. Designing.** Two credit hours. Two three-hour laboratory periods weekly. Short Industrial Arts, second year, first semester. Concurrent, Industrial Arts 101.

**104.** Continuation of 103. Two credit hours. Two three-hour laboratory periods weekly. Short Industrial Arts, second year, second semester. Concurrent, Industrial Arts 102.

**110. Strength of Materials.** Six credit hours. Five recitations and one three-hour laboratory period weekly. Short Industrial Arts, second year, second semester.

Study and strength of properties of materials and their use in machines.

**112. Machine Design.** Two credit hours. Two two-hour periods weekly. Electrical Engineering, fourth year, second semester. Prerequisite, Mechanics 102, and Engineering Drawing 111.

Practical application of principles of machine design.

**114. Shop Building.** Two credit hours. Two recitations weekly. Alternative with Mechanical Engineering 146, fourth year, second semester. Prerequisite, Civil Engineering, 126.

Lectures and problems on the construction of shop building and the arrangement of machinery; special shop appliances.

## SHOPWORK

(The classes in shopwork are carried under a different set of numbers from the preceding theoretical classes in Industrial Arts, though they are in the same department.)

**105. Foundry Work.** One and two-thirds credit hours. One recitation and one three-hour laboratory weekly. Mechanical Engineering, second year, first semester.

Exercises and practise on tempering sand and preparing molds of machine parts in sand, core-making, melting iron and brass, and pouring.

**106.** Repetition of 105. Short Industrial Arts, first year, second semester.

**107. Chipping and Filing.** One and one-third credit hours. Two two-hour laboratory periods weekly. Mechanical Engineering, second year, first semester. Ceramic Engineering, and Short Clay-Working, alternative with 109 and 115.

Exercise and practise in vise work including chipping in cast, and wrought iron, surface filing, squaring, fitting, finishing and the scraping of surface plates.

**108.** Repetition of 107. Short Industrial Arts, first year, second semester.

**109. Joinery and Pattern-Making.** Two credit hours. One recitation and two two-hour laboratory periods weekly. Short Industrial Arts, first year, first semester. Ceramic Engineering and Short Clay-Working, alternative with shopwork 107 and 115; Chemical Engineering, Electrical Engineering, Mechanical Engineering, and Mine Engineering, during the Summer Session at the close of first year.

Exercises and practise in joinery, wood-turning, and pattern-making, including sawing, planing, mortising, framing, and other work involving the use of the ordinary carpenter tools, center and chuck turning, and making of finished patterns.

**110.** Repetition of 109.

**111. Advanced Pattern-Making.** Two credit hours. One recitation and two two-hour laboratory periods weekly. Mechanical Engineering, second year, first semester. Prerequisite, Shopwork 109.

**112.** Repetition of 111. Short Industrial Arts, first year, second semester.

**113. Cabinet-Making.** Two credit hours. Two three-hour laboratory periods weekly. Elective, first semester. Prerequisite, Shopwork 109 or 110.

Exercises and practise in cabinet-making, including paneling, mitre and dove-tail joints; use of power tools.

**114.** Repetition of 113. Elective, second semester.

**115. Forging.** Two credit hours. One recitation and two two-hour laboratory periods weekly. Short Industrial Arts, second year, first semester. Ceramic, Chemical, Electrical, Mechanical, and Mine Engineering, and Short Clay-Working, during the Summer Session at he close of first year.

The use and care of forge, fire, and tools. Practise in iron and steel forging, including such operations as cutting, bending, drawing, upsetting, shaping and welding iron; the making, hardening and tempering of steel punches, chisels, and lathe tools.

**116.** Repetition of 115. Short Mining, first year, second semester.

**118. Advanced Forging.** Two credit hours. Two three-hour laboratory periods weekly. Elective, second semester. Prerequisite, Shopwork 115.

Various forms of welds in iron and steel; the use of scrolling irons and of forms for duplicating work; annealing; tool-making; case-hardening; tempering drills, dies and cutters; spring-making; ornamental iron work; visits to shops.

**119. Machine Work.** Three credit hours. One recitation and two three-hour laboratory periods weekly. Electrical Engineering and Short Industrial Arts, second year.

Elementary exercises on the engine lathe, such as plain, straight, and taper turning, screw cutting, chucking boring, filing and polishing, and the use of the drill press.

**120.** Repetition of 119. Mechanical Engineering, second year, second semester.

**121. Advanced Machine Work.** Three credit hours. One recitation and two three-hour laboratory periods weekly. Mechanical Engineering, third year, first semester. Prerequisite, Shopwork 119 or 120.

A continuation of course 119 or 120 with more difficult exercises on the lathe, including square thread cutting, drilling, and tapping, use of steady rest, face-plate work and bar turning. Also practise on the milling machines, planer, shaper and turret lathe.

**122.** Repetition of 121. Electrical Engineering and Short Industrial Arts, second year, second semester.

**123. Advanced Machine Work.** Two credit hours. Two three-hour laboratory periods weekly. Elective, first semester. Prerequisite, Shopwork 121 or 122.

A more advanced course in milling machine work and grinding. Exercises in spur and spiral gear cutting, cam cutting, and differential and fractional indexing.

**125. Construction Work.** Two credit hours. First semester. Two three-hours laboratory periods weekly. Elective, Prerequisite, Shopwork 121 or 122.

A course in construction work on any piece of apparatus or machinery which may be in course of construction in the shops.

**126.** Repetition of 125. Second semester. Elective.

**127. Tool-Making and Jig Work.** Three credit hours. First semester. Elective. Prerequisite, Shopwork 123.

**128.** Repetition of 127. Three credit hours. Elective, second semester.

### FOR GRADUATES ONLY

For a complete description of the graduate work, the bulletin of the Graduate School should be consulted.

**201-202. Research Work.** Five to ten credit hours. The year. Library, conference and laboratory work. Time to be arranged with the instructor. Prerequisites, Physics 113, 114; Mechanics 101, 102; and Mechanical Engineering 127, 144, or Metallurgy 109, 110, and the permission of the instructor in charge.

Research work with special reference to the application of Physics, Chemistry, Metallurgy and Machine Design to the problems of the metal-working industries. This work is under the supervision of Professor Sanborn and Associate Professor Knight.

## MATHEMATICS

(Office, Room 314, University Hall)

PROFESSORS BOHANNAN, MCCOARD, SWARTZEL, KUHN, ASSOCIATE PROFESSORS ARNOLD, RASOR, ASSISTANT PROFESSORS PRESTON, BAREIS, MORRIS, WEST; MISS RICKARD, MR. HEBBERT

**101. Elementary Algebra.** Five credit hours. Five recitations weekly. Short Clay-working, Short Industrial Arts, and Short Mining, first year, first semester. Text-book, Wentworth's Algebra.

**102.** Continuation of 101. Five credit hours. Five recitations weekly. Short Clay-working, Short Industrial Arts, and Short Mining, first year, second semester. Prerequisite, Mathematics 101.

**113. Plane and Solid Geometry.** Five credit hours. Five recitations weekly. Short Clay-working, Short Industrial Arts, and Short Mining, first year, first semester. Text-book, Venable's Geometry.

**114. Solid Geometry and Plane Trigonometry.** Five credit hours. Five recitations weekly. Short Clay-working, Short Industrial Arts, and Short Mining, first year, second semester. Prerequisite, Mathematics 113. Text-books, Venable's Geometry, and Bohannan's Trigonometry.

**131. Trigonometry and College Algebra.** Five credit hours. Five recitations weekly. All four-year courses in Engineering, first year, first semester. Prerequisites, Entrance Algebra and Geometry. Text-books, Bohannan's Trigonometry and Rietz and Crathorne's College Algebra.

This course is given in the second semester,

**132. Analytical Geometry and College Algebra.** Five credit hours. Five recitations weekly. All four-year courses in Engineering, first year, second semester. Prerequisite, Mathematics 131. Text-books, Candy's Analytical Geometry, and Rietz and Crathorne's College Algebra.

This course is given in the first semester and repeated in the Summer Session.

**141. Calculus.** Five credit hours. Five recitations weekly. All four-year courses in Engineering, second year, first semester. Prerequisite, Mathematics 132.

This course is given in the second semester.

**142.** Continuation of 141. Five credit hours. Five recitations weekly. All four-year courses in Engineering, second year, second semester. Prerequisite, Mathematics 141.

This course is given in the first semester and repeated in the Summer Session.

**151. Differential Equations.** One credit hour. One recitation weekly. Mechanical Engineering, third year, first semester. Prerequisite, Mathematics 142. Text-book: Boyd's Differential Equations.

**169. Differential Equations.** Two credit hours. Two recitations weekly. Elective, first semester. Prerequisite, Mathematics 142. Text-book: Boyd's Differential Equations.

**Higher Mathematics.** Elective. See bulletin of the College of Arts, Philosophy, and Science for special courses. Differential Equations, Fourier's Series and Steinmetz's Mathematical Electricity are particularly recommended to Electrical Engineers.

## FOR GRADUATES ONLY

For a complete description of the graduate work the bulletin of the Graduate School should be consulted.

**201-202. Research Work.** Five to ten credit hours. The year. Library and conference work. Time arranged with the instructor. Prerequisite, the permission of the instructor in charge.

Research work on the Calculus of Variations is given under the supervision of Professor Bohannan; in the Theory of Functions of a Complex Variable, under Associate Professor Rasor; in Elliptic Integrals, under Assistant Professor West; in Potential Functions, under Professor Swartzel; in Fourier's Series and Spherical Harmonics under Professor Swartzel; in the Mathematical Theory of Eectricity and Magnetism, under Professor Bohannan.

## MECHANICAL ENGINEERING

(Office, Room 244, Engineering Laboratory)

PROFESSORS MAGRUDER AND HITCHCOCK, ASSOCIATE PROFESSOR
JUDD, ASSISTANT PROFESSOR VALLANCE, MR. McCLELLAND,
MR. HOPKINS

### EQUIPMENT

The Department of Mechanical Engineering occupies the south end of the Robinson Laboratory. The main laboratory is 90 feet by 112 feet, and is divided into three sections. The steam-engineering section contains three 35-horse power, horizontal, plain and automatic cut-off engines; one 60-horse power tandem compound, horizontal, automatic cut-off engine; one 10-horsepower two cylinder single acting engine; one 30-horsepower tandem, compound, vertical engine with riding cut-offs and link motions; one 250-horsepower, cross-compound, vertical engine, with reheater direct connected to a 20-inch centrifugal pump of 12,000 gallons per minute capacity; one 60-horsepower simple Corliss engine; one 15-horsepower vertical engine, and one 3-horsepower square-piston engine. Most of the above are arranged to be worked as condensing engines if desired, and are provided with surface condensers, air and circulating pumps, ect. The hydraulic section is equipped with eleven cisterns, a flume having a cross-section of thirteen square feet, submerged orifices up to thirty inches in diameter, a 30-foot well, and weirs capable of measuring up to 16,000 gallons per minute. It is provided with simple, compound, triplex, centrifugal, and rotary pumps, steam turbine driven centrifugal pump, pulsometer, turbine and impulse water-wheels, and a variety of apparatus specially adapted to study the flow of liquids. The third section contains Riehlê and Olsen testing machines for materials in tension, compression, bending shear, and torsion; dynamometers for measuring the power supplied to machines; ventilating fans; and the departmental machine shop. Supported by the columns carrying the sawtooth roof, and between the sections, are two galleries, each 8 feet by 108 feet. One of them is used as a drawing room; the other is used to study the flow of steam, air and water through pipes and bends.

Next to the steam laboratory is a section, 48 feet by 144 feet adapted for the operation and testing of steam boilers and gaspower machinery. The boiler laboratory is equipped with a horizontal, internally-fired tubular boiler; a horizontal return-flue boiler, exterior fired with brick setting; a locomotive boiler, and a 107-horsepower Babcock and Wilcox watertube boiler, provided with both an automatic stoker and a Dutch-oven furnace having shaking grates with forced, induced, and chimney drafts; a Foster independently fired superheater, and a complete equipment of testing appliances. The gas engine laboratory has three oil engines and three gas engines of 6 and 10 horsepower, one 10 horsepower, two-cylinder, two-cycle motor-boat gasoline engine fitted with propellors working in a tank; one 25-horsepower, two-cycle, and one 80-horsepower, two-cylinder, tandem, four-cycle, horizontal engine, each operated with either natural gas or producer gas; one 75-horsepower suction gas producer for use with either anthracite gas or bituminous coals, with complete facilities for measuring the fuels, air, and water which are used and the power developed.

Between the boiler room and the electrical engineering laboratory is the demonstration amphitheater and lecture room. In the rear of the amphitheater is a spacious laboratory which is intended for the testing of automobiles and refrigerating machinery but is as yet only partially equipped.

The two-story portion at the south end of the building is used for offices, three class rooms, an engineering museum, locker rooms, oil-testing laboratory, photographic dark-room, and instrument room.

## SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**101 Mechanism.** Three credit hours. Three recitations weekly. Electrical Engineering, third year, first semester. Prerequisites, Engineering Drawing 103, and Physics 114.

Recitations on the principles of mechanism and mechanical movements.

**103. Steam Power Plants.** Three credit hours. Three recitations weekly. Chemical, Electrical, and Mechanical Engineering, third year, first semester. Prerequisites, Engineering Drawing 104 and Physics 112.

A descriptive study of steam-generating and steam using machinery.

**110. Mechanism and Machine Design.** Three credit hours. Three recitations weekly. Ceramic Engineering, third year, second semester. Prerequisite, Drawing 104, Physics 112, and Mechanics 101.

Recitations on the principles of mechanism, mechanical movements, and elementary machine design.

**114. Mechanism.** Three credit hours. Three recitations weekly. Mechanical Engineering, third year, second semester. Prerequisite, Drawing 104, and Physics 112.

Recitations and practise on the principles of mechanism and mechanical movements.

**116. Mechanism Drawing.** One credit hour. One three-hour drawing period weekly. Mechanical Engineering, third year, second semester. Prerequisite or concurrent, Mechanical Engineering 114.

Practise in laying out mechanisms and mechanical movements.

**118. Steam Engines.** Three credit hours. Four recitations weekly. Electrical and Mechanical Engineering, third year, second semester. Prerequisites, Mechanical Engineering 103 and Mechanics 101.

**120. Steam Boilers.** One credit hour. One recitation or lecture weekly. Mechanical Engineering, third year, second semester. Prerequisite, Mechanical Engineering 103 and Mechanics 101.

**121. Heating and Ventilating.** Two credit hours. Two recitations weekly. Architecture, fourth year, first semester. Prerequisite, Mechanics 101.

Recitations and lectures on the principles and methods of heating and ventilation, with laboratory work and investigations of the heating and ventilating plants of different buildings.

**123. Materials of Construction.** Two credit hours. One recitation and one three-hour laboratory period weekly. Required in Architecture, fourth year, first semester. Prerequisite Mechanics 101.

Lectures and recitations on the materials used in architectural and building construction, and laboratory exercises on their properties.

**125. Gas Engines and Producers.** Two credit hours. Two recitations weekly. Required in Mechanical Engineering, fourth year, first semester. Prerequisite, Mechanical Engineering 118.

A study of gas-engines and of gas-producers as used for power purposes.

**127. Machine Design.** Five credit hours. Five recitations weekly. Required in Chemical and Mechanical Engineering, fourth year, first semester. Prerequisites, Drawing 104 and 111, Mechanics 102, and Metallurgy 109.

A detailed course of study based upon mechanics and the materials of construction applied to the design and construction of machinery.

**129. Thermodynamics.** Two credit hours. Two recitations weekly. Required in Mechanical Engineering, fourth year, first semester. Prerequisite, Mechanical Engineering 118.

The transmutations of heat and mechanical energies in steam and air engines, in air and ammonia compressors, and in refrigeration machines, together with a study of the tests of ideal and actual engines, and of their indicator diagrams; the flow of gases through pipes and orifices.

**130. Inspection Trip to the East.** The seventh week before Commencement Week, third or fourth years. Required in Mechanical Engineering. Prerequisite, Mechanical Engineering 103.

Given only in the even years.

Includes Pittsburg, Buffalo, Niagara Falls, Cleveland, and possibly other places. The entire expense need not exceed $32. A satisfactory written report upon the work of the trip is required.

**132. Inspection Trip to the West.** The seventh week before Commencement Week, third or fourth years. Required in Mechanical Engineering. Prerequisite, Mechanical Engineering 103.

Given only in the odd years.

Includes Chicago, Milwaukee, Gary, and possibly other places. The entire cost need not exceed $32. A satisfactory written report upon the work of the trip is required.

**134. Written Report.** Course of assigned reading upon processes of manufacture and power plants taken and reported upon by the third and fourth year students in Mechanical Engineering as a substitute for Mechanical Engineering 130 on presentation of reasons satisfactory to the head of the department. The seventh week before Commencement Week, third or fourth years. Required in Mechanical Engineering.

**136. Written Report.** Similar to Mechanical Engineering 134, as a substitute for Mechanical Engineering 132. The seventh week before Commencement Week, third or fourth years. Required in Mechanical Engineering.

**140. Mechanism and Machine Design.** Two credit hours. Two recitations weekly. Required in Civil Engineering, fourth year, second semester. Prerequisite, Mechanics 102.

An elementary course in the principles of mechanism and mechanical movements and the design of parts of machines.

**142. Hydraulic Machinery.** Two credit hours. Two recitations weekly. Required in Mechanical Engineering, fourth year, second semester. Prerequisite, Mechanies 102, and Mechanical Engineering 118.

A study of pumping machinery.

**144. Machine Design.** Five credit hours. Three recitations and two three-hour drawing periods weekly. Required in Chemical and Mechanical Engineering, fourth year, second semester. Prerequisite, Mechanical Engineering 127.

A continuation of course 127, with practical applications on the drawing board of the principles to the design of some particular machine.

**146. Steam Turbines.** Two credit hours. Two recitations weekly. Optional in Mechanical Engineering with Industrial Arts 114, fourth year, second semester. Prerequisite, Mechanical Engineering 129.

A study of the generation of power by steam turbines, including auxiliary machinery.

**148. Thesis Work.** Three credit hours. Required in Mechanical Engineering, fourth year, second semester. Prerequisite, Mechanical Engineering 125 127 or 129.

A special investigation or design based upon the work of the courses.

**160. Experimental Engineering Laboratory.** Two credit hours˙ One four-hour laboratory period weekly. Required in Electrical Engineering, third year, second semester. Concurrent, Mechanics 102, and Mechanical Engineering 118.

Calibration of pressure gauges and indicator springs, steam engine indicator practice, testing of lubricating oils, and the materials of construction.

**164. Experimental Engineering Laboratory.** Two credit hours. One four-hour laboratory period weekly. Required in Mechanical Engineering, third year, second semester. Concurrent, Mechanics 102, and Mechanical Engineering 118.

Calibration of pressure gauges and indicator springs; steam engine indicator practice; testing of oils and the material of construction.

**171. Experimental Engineering Laboratory.** Four credit hours. Two recitations weekly and one four-hour laboratory period weekly. Required in Ceramic Engineering, fourth year, first semester. Prerequisite, Mechanics 102, and Metallurgy 109.

Lectures and recitations on power transmissions, steam and gas engines, and boilers. Laboratory work in the calibration of pressure gauges and indicator springs; valve setting; testing of steam and gas engines; testing of steam and centrifugal pumps; boiler and fuel trials.

**173. Experimental Engineering Laboratory.** Five credit hours· One recitation weekly and two four-hour laboratory periods weekly. Required in Civil Engineering, fourth year, first semester. Prerequisite, Mechanics 102.

Practice in the testing of the materials of construction; calibration of orifices and weirs; study of the flow of liquids and gases; tests of steam, power, rotary, and centrifugal pumps; tests of water motors and turbine water wheels. Lectures and recitations on same and on steam engines, boilers, and transmission machinery.

**175. Experimental Engineering Laboratory.** Three credit hours. One six-hour laboratory period weekly. Required in Electrical Engineering, fourth year, first semester. Prerequisite, Mechanical Engineering 118 and 160.

Tests of steam engines and boilers; gas and oil engines; steam and power pumps; hydraulic experimentation; and the use of transmission and absorption dynamometers.

**179. Experimental Engineering Laboratory.** Two credit hours. One four-hour laboratory period weekly. Required in Mechanical Engineering, fourth year first semester. Prerequisite, Mechanical Engineering 164. Concurrent, Mechanical Engineering 125 and 129.

Valve setting, moisture determinations in steam, gas calorimetry, measurements of flow of water by means of orifices, nozzles, weirs, and venturi-meter; tests of belts with use of transmission and absorption dynamometers.

**190. Experimental Engineering Laboratory.** Six credit hours. Four three-hour laboratory periods weekly. Required in Mechanical Engineering fourth year, second semester. Prerequisites, Mechanical Engineering 125, 129 and 179.

Tests of steam and hot air engines; steam boilers; gas and oil engines; gas producers; air compressors; injectors and pulsometers; centrifugal-rotary, and power pumps; hydraulic rams, impulse and turbine water wheels; fans and blowers and steam turbines.

**192. Experimental Engineering Laboratory.** Three credit hours. One recitation weekly and one four-hour laboratory period weekly. Required in Mine Engineering, fourth year, second semester. Prerequisites, Mechanics 102, and Metallurgy 109.

Lectures and recitations on power transmission, steam and gas engines, steam boilers, and gas producers. Laboratory work in the calibration of pressure gauges and indicator springs; valve setting; testing of steam engines; testing of steam and centrifugal pumps; boiler and fuel trials; tests of gas engines and gas producers.

### FOR GRADUATES ONLY

For a complete description of the graduate work, the bulletin of the Graduate School should be consulted.

**201-202. Research Work.** Five to ten credit hours. The year. Library, Conference and Laboratory work. Time arranged with the instructor. Prerequisite, the permission of the instructor in charge.

Research work in gas enginry is conducted under the supervisior of Professor Magruder; in steam enginry and fuel testing, under Professor Hitchcock; in applied hydraulics, under Assistant Professor Judd.

## MECHANICS

(Office, Room 233, Mines Building)

PROFESSOR J. E. BOYD, ASSOCIATE PROFESSOR CODDINGTON,
MR. PERRY

### EQUIPMENT

The Department of Mechanics occupies rooms in the Mines Building. The equipment consists of apparatus for a limited number of class room experiments designed to illustrate the fundamental facts of the science. It includes pulleys, platform scales, spring balances, a three-foot graduate circle for resolution of forces, apparatus for demonstrating couples in parallel planes, a chain for catenary experiments, model for shear and moment in beams, and apparatus for measuring acceleration and accelerating force.

The Department has a set of special extensometers for determining the maximum stress in bridge columns, and a second set for photographically recording the stresses due to moving trains. These are used jointly with the Department of Civil Engineering in thesis investigations.

The laboratory work in strength of materials, involving the use of testing machines, is given at present in the Department of Mechanical Engineering.

### SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**101. Statics and Strength of Materials.** Five credit hours. Architecture, Ceramic, Chemical, Civil, Electrical, Mechanical and Mine Engineering, third year, first semester. Prerequisite, Mathematics 142.

**102. Strength of Materials, Continued, Kinetics and Hydraulics.** Five credit hours. Chemical, Civil, Electrical, Mechanical and Mine Engineering, third year, second semester. Prerequisite, Mechanics 101.

**104. Strength of Materials.** Two credit hours. Architecture and Ceramic Engineering, third year, second semester, Prerequisite Mechanics 101.

### FOR GRADUATES ONLY

For a complete description of the graduate work, the bulletin of the Graduate School should be consulted.

**201-202. Advanced Theoretical Mechanics.** Three credit hours. The year.

Library and Conference work. Time to be arranged with the instructor. Prerequisite, Mechanics 101-102, and the permission of the instructor in charge. This work is done under the supervision of Professor Boyd and Associate Professor Coddington.

## METALLURGY AND MINERALOGY

(Office, Room 100, School of Mines Building)

PROFESSOR SOMERMEIER, ASSISTANT
PROFESSORS DEMOREST AND McCAUGHEY

### EQUIPMENT

The equipment of this department is unusually complete. It occupies about 14,000 square feet of floor space at the east end of the basement and first floor of the School of Mines. In addition to the lecture rooms, there are separate laboratories for the following lines of work: For the analysis and assaying of iron, steel, ores, and furnace products by wet methods; for fire assaying and testing of gold and silver ores, equipped with furnaces and cyanide plant; for general and determinative mineralogy, equipped for blowpipe analysis and for the microscopic examination of minerals; for the calorimetric examination of coals and other fuels, technical gas analysis and the examination of mine air; for the microscopic examination and thermal tests of metals; and for the analysis and complete examination of coals. There is also a crushing and sampling plant for experimental tests on ores and minerals. The department now has a complete model New Century coal jig, a small experimental ore jig, and other apparatus for the practical testing of coal and ores by washing methods. The museum contains a large number of specimens and is being rapidly developed.

## SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**102. Mineral Chemistry.** Four credit hours. Short Mining second year, second semester. Prerequisite, Chemistry 101.

A course of lectures upon mine gases, safety lamps, mine explosions, boiler water, mine water, water supply, explosives, coal and coke.

**104. Crystallography and Mineralogy.** Three credit hours. Mine Engineering, second year, and Chemical Engineering, third year, second semester. Prerequisite, Chemistry 106.

Lectures on Crystallography and Physical Mineralogy. Illustrated by drawings, models and mineral specimens

**105. Fire Assaying.** Three credit hours. Mine Engineering, third year, first semester. Laboratory, two afternoons per week. Monday and Tuesday, or Thursday and Friday. Prerequisite, Metallurgy 106, or equivalent.

Lectures and laboratory work. Practical work in the assaying of gold, silver, and lead ores.

**106. Metallurgical Analysis.** Four credit hours. One lecture, nine hours laboratory weekly. Mine Engineering, second year, second semester. Prerequisite, Chemistry 106 or 110, and Chemistry 119.

Lectures and laboratory work. Laboratory work in the analysis of iron ores, iron and steel, fuel and slags, and ores of lead, zinc, and copper by wet methods, using approved methods as practised in technical laboratories and metallurgical works.

**107. Alloy Analysis.** Four credit hours. One lecture, nine hours laboratory weekly. Mine Engineering, third year, first semester. Prerequisite, Metallurgy 106.

Lectures and laboratory work. Laboratory work in the analysis of alloy steels, such as vanadium, tungsten, chromium, nickel and molybednum steels, and other alloys. Quantitative work preceded by qualitative tests on the alloys.

**108. Determinative Mineralogy.** Three credit hours. One lecture two three-hour laboratory periods weekly. Mine Engineering, third year second semester. Prerequisite, Metallurgy 104.

Lectures and laboratory work in practical determination of minerals by physical and chemical tests. Each student is furnished with a set of apparatus and works under an instructor's inspection. Brush and Penfield's Determinative Mineralogy is used as a manual.

**109. General Metallurgy.** Four credit hours. Mine Engineering, Mechanical Engineering, Chemical Engineering, third year, first semester; Ceramic Engineering, fourth year, first semester. Prerequisites, Chemistry 106, and Physics 114. Three lectures, one section; and two recitations in two sections.

Lectures and recitations on general metallurgy, fuels, iron and steel, their properties and manufacture.

**110. Metallurgy of Non-Ferrous Metals.** Four credit hours. Mine Engineering, third year, second semester. Three lectures, two recitations.

Lectures and recitations on the metallurgy of the non-ferro metals; copper, lead, gold, silver, etc. Their properties, reduction, and purification.

**111. Metallurgical Construction.** Two credit hours. Mine Engineering, fourth year, first semester. Prerequisites, Drawing 111, Mechanics 102, Metallurgy 109 and 113.

Lectures and drawing room practice on the designing of furnaces and metallurgical plants.

**112. Technical Gas Analysis.** Two credit hours. Mine Engineering, third year, second semester. Two afternoons per week. Prerequisites, Metallurgy 106, 109 or equivalent.

Laboratory work supplemented by lectures. Technical analysis of metallurgical and mine gases. Determination of the calorific value of gases; problems involving application of results of gas analysis to furnace operation, mine ventilation, etc.

**113. Ore Dressing and Coal Washing.** Two credit hours. Mine Engineering, fourth year, first semester. Prerequisite, Metallurgy 109.

Methods of concentrating and enriching ores and fuels by mechanical means. Lectures with references to standard books and various papers in technical journals.

**114. Special Metallurgy.** Three credit hours. Mine Engineering fourth year, second semester. Hours to be arranged. Prerequisites, Metallurgy 106, 107, 109, 110, or equivalent.

Lectures and laboratory, supplemented by lectures on mine gases and water, safety appliances, explosives, microscopic examination of metals, study of properties of alloys, testing of metallurgical processes, pyrometry, and high temperature measurements, calorimetry, and other tests on fuels.

**116. Thesis.** Three credit hours.

**117. Advanced Crystallography and Physical Mineralogy.** Three credit hours. First semester. Two lectures and one laboratory period.

The study of the geometrical and physical properties of crystals. Laboratory work on the measurement, calculation and projection of crystals and the determination of physical and optical constants of crystallized bodies. Prerequisites, Physics and Chemistry.

**118. Microscopic Mineralogy.** Three credit hours. Second semester. One lecture and two laboratory periods.

The use of the polarizing microscope in the identification of minerals in fine powder and in thin section. Determination of the optical constants of minerals and crystallized bodies with a polarizing microscope. Prerequisite, Metallurgy 104, Physics and Chemistry.

## FOR GRADUATES ONLY

For a complete description of the graduate work, the bulletin of the Graduate School should be consulted.

**201. Research Work.** Three to five credit hours. First semester. Library, Conference and Laboratory work. Time arranged with the instructor. Prerequisite, the permission of the instructor in charge.

These courses are under the supervision of Professor Somermeier and Assistant Professor Demorest.

(a) **Iron, Steel and Other Alloys.** Investigations on the composition, properties, structure and heat treatment. Prerequisite, Metallurgy 114.

(b) **Fuels.** Investigations on composition, conservation and utilization. Prerequisite, Metallurgy 114.

(c) **Investigations on the Metallurgy and Analysis of the Less Common Metals,** as tin, antimony, bismuth, tungsten, etc. Prerequisites, Metallurgy 106 and 109.

(d) **Investigation of Special Metallurgical Processes,** as the electrolytic refining of lead, etc. Prerequisites, Metallurgy 106 and 109.

# MILITARY SCIENCE AND TACTICS

(Office, The Armory)

CAPTAIN GEORGE L. CONVERSE, U. S. A., RETIRED

In accordance with the Morrill Act, passed in 1862, under which the University was established, military instruction must be included in the curriculum. The Board of Trustees therefore requires all male students, unless excused by the Military and Gymnasium Board, to drill during two years. This work is under an officer of the regular army, detailed for the purpose. The Military Department is open during five days each week throughout the year.

## EQUIPMENT

The equipment of the Military Department comprises 1000 standard U. S. Magazine rifles, with belts, bayonets and accoutrements, 51 regulation infantry officers' sabres and belts, 25 cadet swords and belts, a stand of regimental colors, with markers, guidons, etc. The target practise equipment comprises 6 Springfield gallery rifles and 7 Winder-Model Winchester gallery rifles, 5 targets for 100, 200 and 300 yards, and 5 Winder-Model targets for long range. The band comprises about 60 pieces, partly supplied by the University and partly owned by the members.

The office is equipped for recording the attendance and performance of each cadet in drill, target practice and class-room work.

## ORGANIZATION

Cadet regiment is organized into three battalions of four companies each, a band, and trumpet corps. Each battalion has its own staff officers. The total number of men under arms averages about one thousand at present. Service in the band is credited as military service. The appointment of cadet officers during the second year of service is for excellence in their work. These officers may continue to serve during the third and fourth years if they wish, and if they do, are given compensation at the end of each year's satisfactory service amounting to not less than twenty ($20.00) dollars for lieutenants and captains, and larger sums for officers of higher ranks. Members of the band who volunteer for service after having completed their two years required duty are also paid at the rate of $20.00 per year, and receive instruction during the four winter months from a competent band-master.

## SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**1. Military Drill.** One credit hour. Five months, three hours per week (divided between fall and spring) military drill; four months, three hours per week, (winter) of class-room instruction in drill regulations. Target practice at any open hour during the afternoons of the winter months, at 100, 200 and 300 yards. Lecture, one hour weekly, by the President, upon topics of common interest to the student body.

**2. Military Drill.** One credit hour. Five months, three hours per week, (divided between fall and spring), in extended order and guard duty. Four months, three hours per week (winter) of class-room instruction in Articles of War, guard manual and field service regulations. Target practice, at any open hour of the afternoons of the winter months, at 500, 600 and 800 yards.

# MINE ENGINEERING

(Office, Room 200, Mines Building)

PROFESSOR RAY, ASSISTANT PROFESSOR MINOR

## EQUIPMENT

The department occupies the east end of the second floor of the Schools of Mines Building and one basement room, and has a floor space of 6000 square feet. This includes the office of the department, a large lecture room, a drawing room with accommodations for fifty students, a blue-print room with full equipment for both sun and electric light printing, a laboratory for safety lamp testing and other special work, and in the basement a large room for work in ventilation.

The equipment includes all of the latest improved instruments and apparatus used in mine surveying and mine ventilation. There are a variety of surveying instruments for general practice, also targets, plummet lamps, etc., for mine and tunnel work. The laboratory contains apparatus for the testing and an outfit for the repair of safety lamps; and practise tests are made with the lamps for the detection and estimation of fire damp. An outfit for special analytical, chemical and mineralogical work is also available for use at all times. A growing collection of models of mines, smelters, ore dressing plants, coal tipples, metal head frames, split construction and the various types of framing are used in connection with the lectures and are kept in the museum for the use of the students. For the practical study of ventilation the equipment is complete, and includes anemometers, water gauges, barometers, barographs, polymeters, registers, etc., most of which are self-recording; there are also a portable gas apparatus and various forms of rescue apparatus.

## SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**101. Mine Engineering.** Five credit hours. Lectures and field practise. Short Course in Mining, second year, first semester. Prerequisite, Mathematics 114. This course is similar to Course 103, but more elementary. The same text is used. The students have more practise in the drawing room.

**102. Mine Engineering.** Five credit hours. Short Course in Mining, second year, second semester. Prerequisite, Mine Engineering 101 and Physics 101. Lectures illustrated by experiments, and maps of mines and models when possible; tests by safety lamps and anemometers; methods of air distribution in coal mines

**103. Mine Engineering.** Mine Surveying. Four credit hours, Mine Engineering, second year, first semester, and Ceramic Engineering, third year, first semester. Prerequisites, Engineering Drawing 104, and Mathematics 132. Field practise in the use of instruments for surface and underground surveys. Field notes are taken and maps and plans made in the drawing room.

**104. Mine Engineering.** Plans and Specifications. Four credit hours. Mine Engineering, fourth year, second semester. Prerequisite, Mine Engineering 105, and Metallurgy 111. Practise in designing mine plants, drafting and estimating.

**105. Mine Engineering.** Five credit hours. Mine Engineering, fourth year, first semester. Prerequisites, Mechanics 102, Mine Engineering 103 and Geology 165. Lectures on mine operating, mining machinery, ventilation, shaft sinking, working out deposits, etc. Constant reference is required to standard works and to the leading technical journals.

**106. Mine Engineering.** Five credit hours. Mine Engineering, fourth year, second semester. Prerequisite, Mine Engineering 105. A continuation of Mine Engineering 105.

**107. Mine Engineering.** Two credit hours. Two two-hour drawing periods weekly. Short Mining, second year, first semester. Mine Engineering 101, concurrent.

**109. Mine Trip.** One credit hour. First semester.

**110. Mine Trip.** One credit hour. Second semester.

**116. Thesis.** Three credit hours.

### FOR GRADUATES ONLY

For a complete description of the graduate work, the Bulletin of the Graduate School should be consulted.

**201-202. Research Work.** Three to five credit hours. The year. Library, conference, laboratory and field work. Time arranged with the instructor. Prerequisite, the permission of the instructor in charge.

Mine accidents; preventive regulations; statutory provisions; mine fires; mine explosions; gas indicators; rescue operations; rescue appliances. This work is under the supervision of Professor Ray and Assistant Professor Minor.

## PHYSICAL EDUCATION FOR MEN

(The Gymnasium)

PROFESSOR WINGERT, MR. BAUER. MR. ALEXANDER

### EQUIPMENT

The University recognizes the need for the physical as well as the mental development of the students and provides the necessary means to meet this need. The work is done under a Director, who is a graduate physician and a member of the Faculty.

### SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**1. Physical Education.** One credit hour. Two hours per week for one year. (a) Lectures on hygiene and physiology of exercise, first two weeks, first semester. (b) Corrective: A graded course of free hand exercise, stretching, relaxing, stimulating, exercise with light hand apparatus for the relief and correction of slight body defects, deformities, improper carriage, etc. (c) Educative: Graded progressive exercise on the apparatus and mats to promote muscular tone, vigor, vitality, endurance. (d) Recreative: Gymnasium games, mental relaxation, non-competitive exercises.

**2. Advanced Exercises.** Elective. (a) Advanced exercises on the apparatus and mats. (b) Combatative exercises—boxing, fencing, wrestling. A small charge is made to those electing this work (c)

Recreative: Football, baseball, basketball, tennis, track and field sport, cross-country running, etc. Special hours are arranged for those electing the above exercise and credit given in regular course.

## PHYSICS

(Office, Room 24, Physics Building)

PROFESSOR COLE, ASSOCIATE PROFESSOR EARHART, ASSISTANT PROFESSORS SMITH, SHEARD, AND BARNETT, MR. HEIL, MR. POTE, MR. WEIMER, AND DEPARTMENT FELLOWS

### EQUIPMENT

This science, upon the principles of which so much of the work of all classes of engineers is based, is well housed in the Physics Building. A lecture room, capable of seating 250 students, and with fine equipment, is used for the lectures of the second year. This course also includes recitations and laboratory work. The equipment for the latter permits each student to perform experiments illustrating the work coverd in class. For the special laboratory work in mechanics and heat the equipment is good, including apparatus for showing the composition of forces, acceleration of gravity, balances, chronometers chronographs, cathetometers, calorimeters, and various other forms of heat apparatus. In electricity and magnetism, upon which the work of the electrical engineering course so largely depends, the equipment is unusually complete, including, besides the necessary galvanometers, resistance boxes, voltmeters, ammeters, wattmeters etc., many special instruments such as oscillographs, potentiometers, photmetric apparatus and watt-hour meters. The laboratories for this work are located in the basement and are liberally provided with slate-capped brick piers and wall brackets which give excellent conditions for the use of galvanometers. The laboratories are thoroughly wired, and a large storage battery as well as a motor generator set and and mercury vapor converter furnish current.

### SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**101. Elementary Physics.** Six credit hours. Five recitations and lectures, one three-hour laboratory period wrekly. Short Clay-working second year, first semester. Short Mining, first year, first semester. Text-book, Millikin and Gale's Elements of Physics.

**111. General Physics.** Three credit hours. Two lectures, one recitation, and one two-hour laboratory period weekly. Architecture, Chemical, Civil, and Mine Engineering, second year, first semester. Prerequisites, Preparatory Physics and Mathematics 132.

**112.** Continuation of Physics 111. Three credit hours. Two lectures, one quiz, and one two-hour laboratory period weekly. Chemical, Civil, Mine, and Mechanical Engineering. Prerequisite, Physics 111.

**113. General Physics.** Mechanics and Heat. Five credit hours. Two lectures, three recitations, and one two-hour laboratory period weekly. Ceramic, Electrical, and Mechanical Engineering, second year, first semester. Prerequisites, Preparatory Physics and Mathematics 132.

**114. General Physics.** Electricity, Light and Sound. A continuation of Physics 113. Five credit hours. Two lectures, three recitations, and one two-hour laboratory period weekly. Ceramic and Electrical, second year, second semester. Prerequisite, Physics 113.

**133. Physical Laboratory.** Two credit hours. Two two-hour laboratory periods weekly. Electrical Engineering, second year, first semester. Concurrent Physics 113.

**134. Physical Laboratory.** Three credit hours. Two three-hour laboratory periods weekly. Electrical Engineering, second year, second semester. Concurrent Physics 114.

**135. Physical Laboratory.** Five credit hours. Three three-hour laboratory periods weekly. Electrical Engineering, third year first semester. Prerequisites, Physics 114 and 134.

Theory and practise of magnetic and electrical measurement, including the testing and standardizing of instruments; conductivity of conductors; insulation, capacity and resistance of insulated conductors and cables; temperature co-efficients; commercial measuring and testing instruments; strength and distribution of magnetic fields; magnetic moments; permeability; photometry of gas, electric, and other lights

**137. Physical Laboratory.** Three to five credit hours. Prerequisite or Concurrent Physics 111. Elective.

**138. Physical Laboratory.** Two credit hours. Two two-hour laboratory periods weekly. Mechanical Engineering, second year, second semester. Prerequisite, Physics 111; Concurrent 112. Elective, three to five credit hours. Prerequisite 111, Concurrent 112.

**139. Physical Laboratory.** Three to five credit hours. A second year's work in Physical Laboratory. Elective, first semester. Prerequisite, Physics 135 or equivalent.

**140. Physical Laboratory.** Three to five credit hours. A continuation of Physics 139. Elective, second semester.

### FOR GRADUATES AND ADVANCED UNDERGRADUATES

For a complete description of the graduate work, the bulletin of the Graduate School should be consulted.

**123-124. Advanced Laboratory.** Three to five credit hours. The year. Prerequisite, Physics 121-122. Assistant Professor Smith.

**144. Electricity.** Three credit hours, second semester. Prerequisite, Physics 103-104 or 105-106; calculus precedes or accompanies. Associate Professor EARHART.

### FOR GRADUATES ONLY

***203-204. Theoretical Mechanics.** Three credit hours. The year. Prerequisites, Physics 105-106, and Mathematics 141-142, or equivalents. Assistant Professor Blake.

**205-206. Thermodynamics, and Electrolytic Conduction.** Two credit hours. The year. Prerequisites, Physics 105-106, and Mathematics 141-142, or equivalents. Assistant Professor SMITH.

***207-208. Theory of Electricity and Magnetism.** Three credit hours. The year. Prerequisites, Physics 105-106, and Mathematics 141-142, or equivalents. Assistant Professor SMITH.

**211-212. Theory of Oscillations with Applications to Wireless Telegraphy.** Two credit hours. The year. Prerequisite, Physics 105-106, and Mathematics 141-142, or equivalents. Alternates with 213-214. Assistant Professor BLAKE.

## ROMANCE LANGUAGES AND LITERATURES

(Office, Room 305, University Hall)

PROFESSORS BOWEN AND BRUCE, ASSOCIATE PROFESSOR INGRAHAM,
ASSISTANT PROFESSOR HAMILTON, MR. CHAPIN, MR. ROCKWOOD, MR. BOND

### FRENCH

**101-102. Elementary French.** Four credit hours. The year. Four recitations weekly, first year. May be taken by students in any four-year course who enter with no entrance credits in French. Text-books: Fraser and Squair's Grammar, or equivalent, and Aldrich and Foster's or Bowen's First Scientific Reader.

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*Not Given in 1912-1913.

**103. Modern French Literature**. Four credit hours. Four recitations weekly, first year, first semester. May be taken by first year students in any four-year course who enter with two units entrance credits in French. Prerequisite, French 101-102, or two units entrance credits.

Nineteenth Century Prose, including (1) Contes, (2) the novel (Balzac or Hugo). Prose Composition. Systematic attention given to syntax and idiom.

**106. Science Reading**. Four credit hours. Four recitations weekly, first year, second semester. Must be taken by students in Engineering who take French 103 during the first semester.

A course of rapid reading introductory to the vocabulary of scientific literature.

## SPANISH

**101-102. Elementary Spanish**. Four credit hours. The year. Four recitations weekly, first year. May be taken by students in any four-year course who enter with no entrance credits in Spanish. Grammar, Hills & Ford's or equivalent, and Ingraham's Victoria y Otros Cuentos. Easy Prose and Plays. Composition and Practice in speaking.

**103-104. Modern Spanish Literature**. Four credit hours. The year. Four recitations weekly. May be taken by students who enter with two units entrance credits in Spanish. Prerequisite, Spanish 101-102, or two units entrance credits.

The Novel and Drama of the nineteenth century. Composition and practice in speaking continued.

## SHOPWORK

(See Industrial Arts)

## SPANISH

(See Romance Languages)

# ENROLMENT

November 1, 1911

| | |
|---|---|
| Students in Four-Year Courses Leading to Degrees | 758 |
| Students in Short Courses not Leading to Degrees | 14 |
| Special Students | 11 |
| Total | 783 |

## Classification by Courses

| Name of Course Pursued | 4th year | 3d year | 2d year | 1st year | Unclassified | Total |
|---|---|---|---|---|---|---|
| First Year (Four-Year Courses) | .... | .... | .... | 262 | .... | 262 |
| Architecture | 11 | 13 | 15 | .... | .... | 39 |
| Ceramic Engineering | 14 | 16 | 12 | .... | .... | 42 |
| Chemical Engineering | 16 | 12 | 25 | .... | .... | 53 |
| Civil Engineering | 26 | 41 | 34 | .... | .... | 101 |
| Electrical Engineering | 35 | 38 | 50 | .... | .... | 123 |
| Mechanical Engineering | 23 | 25 | 51 | .... | .... | 99 |
| Mine Engineering | 11 | 12 | 16 | .... | .... | 39 |
| Special | .... | .... | .... | .... | 11 | 11 |
| Clayworking (Short) | .... | .... | 4 | 1 | .... | 5 |
| Industrial Arts (Short) | .... | .... | 1 | 5 | .... | 6 |
| Mining (Short) | .... | .... | 3 | .... | .... | 3 |
| Total | 136 | 157 | 211 | 268 | 11 | 783 |

# GRADUATES

November 1st, 1911

**Classification by Courses**

| Name of Courses | Degree Conferred | | Number of Graduates |
|---|---|---|---|
| Architecture | C. E. (in Arch.) | | 18 |
| Ceramic Engineering | E. M. (in Cer.)<br>Cr. E. | 13<br>56 | 69 |
| Chemical Engineering | B. Sc. (in Chem.)<br>B. Sc. (in Chem. Eng.) | 42<br>17 | 59 |
| Civil Engineering | C. E. | | 302 |
| Electrical Engineering | M. E. in E. E. | | 304 |
| Industrial Arts | B. Sc. (I. A.) | | 6 |
| Mechanical Engineering | M. E. | | 229 |
| Mine Engineering | E. M. | | 143 |
| Advanced Degrees | M. Sc<br>D. C. E. | 3<br>1 | 4 |
| Total | | | 1134 |
| Less names counted twice | | | 6 |
| Net Total | | | 1128 |

# GENERAL INFORMATION

## SCHOLARSHIP

The Stillman W. Robinson Scholarship in Engineering, endowed for the encouragement of graduate research in engineering, provides five hundred ($500.00) dollars annually, and is open to graduates in Mechanical, Civil, and Electrical Engineering. Any student to whom this scholarship is awarded must devote his entire time to the work, which shall amount to at least sixteen hours per week, of which at least eight shall be in the line of original research or investigation. For one year's work and a satisfactory thesis, a master's degree may be given. For two year's work, and a satisfactory thesis, a doctor's degree may be given. For further information consult or address the Secretary of the College of Engineering.

## FEES

All fees must be paid at the opening of each semester as a condition of admission to classes.

**Tuition**—Tuition is free in this College, but registration is not complete until certain incidental and laboratory fees are paid.

**Incidental Fees**—The fee for students who are residents of Ohio is ten dollars a semester. For non-residents, the fee is fifteen dollars a semester. Children of non-resident Alumni pay the same fee as residents of Ohio.

Former students, who do not pay this fee until the third day of the first semester and the second day of the second semester, must pay one dollar additional. For each day of delinquency thereafter, fifty cents is added.

**Laboratory Fees**—A fee of two dollars a semester is charged for all laboratory courses using gas, water, electrical current or steam. For all other courses which are not purely lecture courses, a laboratory fee of one dollar is charged. Students are required to pay for all materials consumed in laboratory work. To meet the cost of these materials, a deposit for each course requiring such supplies is made at the Bursar's office before the work is begun. In Chemistry the deposit is ten dollars. In other courses it varies with the amount of materials used. All laboratory supplies are sold at the General Store Room, Chemistry Hall, to students at about first cost to the University, and charged against the deposits. Any unused part of the deposits refunded at the end of the semester.

## OTHER EXPENSES

**Locker Fee**—The gymnasium is free to all students, but those desiring to use a locker are charged a fee of two dollars a semester, which includes the cost of towels.

**Cadet Uniform**—The uniform with which the members of the regiment are required to provide themselves costs (without overcoat) about thirteen dollars. New students are advised against the purchase of second-hand uniforms, and should not arrange for uniforms until so directed by the Military authorities. Contracts are made by the University with reliable firms to supply uniforms at reasonable prices.

The uniform is quiet in pattern, and may be worn in place of civilian dress.

**Changes in Subjects or Schedule**—After ten days from registration day changes in subjects or schedule, if made at the request of the student, shall be made only upon the payment of a fee of $1.00 for each change. Requests for changes for the second semester must be filed with the College Secretary on or before the third day of the semester, or the fee of $1.00 will be assessed for each change made at the request of the student.

**Graduation Fee**—A fee of five dollars, to cover expense of graduation and diploma, is required of each person receiving one of the ordinary degrees from the University, and this fee must be paid before the degree is conferred. A like fee of ten dollars is charged each person receiving one of the higher graduate degrees.

**Rooms and Board**—Furnished rooms accommodating two students, can be rented at one dollar to one dollar and a half per week for each student. Board at the restaurants and boarding clubs near the University costs from two dollars and seventy-five cents to three dollars and fifty cents per week. The Ohio Union Commons offers board to men at reasonable rates. Board, with furnished rooms, can be obtained in private families at rates varying from five to six dollars per week.

**The Ohio Union**—A fee of one dollar a semester is paid by all male students at registration. This entitles the student to all privileges of the Union, consistent with the Constitution and House Rules governing it.

**Text-Books**—Students should not purchase text-books until they are advised by the instructors of their respective classes.

In order to meet all the neccessary expenses of registration, books, uniform and other expenditures incident to securing a room and board, a student should come prepared to expend about fifty dollars during the first ten days of a semester. After that period his board and room rent will constitute the major part of his expenses.

The element of economy on the part of the student enters somewhat into the cost of pursuing laboratory courses. For this reason it is impossible to fix accurately the costs for a semester or a year. In pursuing the courses of the College of Engineering, it is not likely that a student could get through a year's work with an expenditure in fees of less than thirty ($30.00) dollars, nor is it likely that the amount would ever exceed fifty ($50.00) dollars, except in cases of fines being assessed for gross carelessness or needless distruction of property.

The total expense per year, exclusive of clothing and traveling expenses, is from $275 to $400, according to the degree of economy exercised by the student.

## SELF SUPPORT

There is a considerable amount of work upon the farm and in the shops and laboratories of the University which may be assigned to students on application. Preference is given to those studying Agriculture or one of the Engineering courses. *The University cannot promise work to all applicants.* Many students find work in private families, in offices, and in various occupations, by means of which they defray at least a portion of their expenses. A person of ability and energy, who is master of a trade or who can do good work of any kind, can generally find remunerative employment. It has seldom been found that any student of ordinary energy and industry was obliged to leave the University because of lack of money for necessary expenses, after having been sixty days on the ground—or long enough to inform himself as to the opportunities for securing employment. As an accommodation, the Executive office coöperates as far as possible in this matter. The Y. M. C. A. offers its services in helping young men to secure employment. Very much depends, however, on the individual's power of initiative. Students should not come to the University expecting others to find places for them. They should report to the executive office from time to time as to their needs and their work. This will enable the authorities to be more helpful than otherwise would be possible.

A student devoting much of his time to earning his way will be unable to carry successfully the full amount of collegiate work. Such students should apply for the privilege of carrying reduced work.

This, of course, means that the time required to obtain a degree will be extended to five or more years, according to the amount of work successfully carried each year.

**Consultation**—For consultation in regard to their status as members of the College of Engineering, or for the filing of petitions, changes of course, of class cards, adjustment of schedules and similar needs, students will apply to the Secretary, Mines Building, Room 131, from 10 to 11 a. m.

## Y. M. C. A.

The Young Men's Christian Association has come to occupy a prominent place in university life. It has a membership of about five hundred men, and is affiliated with the World's Student Christian Federation.

Religious meetings are held for men on Sunday afternoon; there are also frequent meetings for the promotion of social intercourse and good fellowship. Courses in systematic Bible study and in modern missions are offered. A most helpful feature of the work is that in the interest of new students at the opening of the school year. Desirable rooms and boarding places are found and posted for reference at the Association Office. Representatives of the Association meet the trains, assist students in finding satisfactory locations, and endeavor in every way to make them feel at home. The Employment Bureau helps to find work.

A copy of the Students' Handbook, giving information about Columbus, the University, and the various college organizations and activities, will be sent free to prospective students. For this handbook or for further information, address the General Secretary of O. S. U. Y. M. C. A., University Campus, Columbus, Ohio.

The Ohio State University Bulletin is issued at least twenty times during the year; monthly in July, August, September and June, and bi-weekly in October, November, December, January, February, March, April and May.

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The Ohio State University Bulletin
VOLUME XVII JANUARY, 1913 NUMBER 17

LIBRARY

# COLLEGE OF ENGINEERING

## 1913-14

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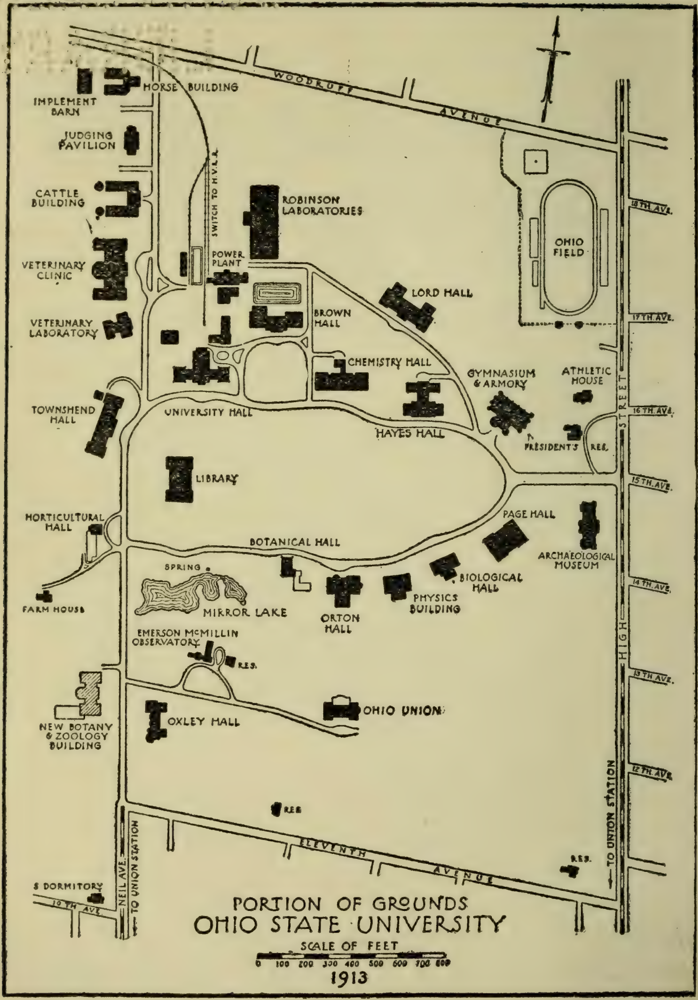

PORTION OF GROUNDS
OHIO STATE UNIVERSITY

1913

# THE OHIO STATE UNIVERSITY

The Ohio State University, located in Columbus, is a part of the public educational facilities maintained by the State. It comprises seven colleges and a graduate school:

The College of Agriculture,
The College of Arts, Philosophy and Science,
The College of Education,
The College of Engineering.
The College of Law,
The College of Pharmacy,
The College of Veterinary Medicine,
The Graduate School.

This bulletin of announcements is devoted exclusively to the work of the College of Engineering, offered during the academic year beginning September, 1913.

[NOTE—The University publishes a bulletin descriptive of each College. Copies may be obtained by addressing W. E. Mann, University Editor, Columbus, Ohio, and stating the college in which the writer is interested.]

# UNIVERSITY CALENDAR

## 1913

Entrance examinations, Tuesday to Saturday, June 3 to 7 8 a. m.

Summer Session, June 16 to August 8.

Entrance examinations, Tuesday to Saturday, September 9 to 13 8 a. m.

First semester begins—Registration Day—Tuesday, September 16.

President's Annual Address, Friday, September 19, 11 a. m.

Latest date of admission to candidacy for a degree at the Commencement of June, 1914, Wednesday, October 1.

Date for mid-semester reports to the Deans concerning delinquent students, Wednesday, November 19.

Thanksgiving recess begins November 26, 6 p. m. and ends December 2, 8 a. m.

Christmas recess begins Friday, December 19, 6 p. m,

## 1914

Christmas recess ends Tuesday, January 6, 8 a. m.

Winter Course in Agriculture and Dairying begins Monday, January 5.

Final examinations, Friday, January 30, to Thursday, February 5.

First semester ends Thursday, February 5, 6 p. m.

Second semester begins—Registration Day—Tuesday, February 10.

Washington's Birthday, Sunday, February 22.

Mid-semester reports to the Deans, Saturday, March 28.

Easter recess, Saturday, April 4, 12 m., to Tuesday, April 14, 8 a. m.

Eastern inspection trip, April 26 to May 3.

Competitive Drill—Cadet Regiment—Saturday, May 23.

Memorial Day, Saturday, May 30.

Final examinations, Friday, June 5, to Thursday, June 11.

Entrance examinations Tuesday, June 9, to Saturday, June 13, 8 a. m.,

Commencement, Wednesday, June 17.

# THE COLLEGE OF ENGINEERING

The purpose of the College of Engineering is to instruct students thoroughly in the fundamental sciences and arts upon which all engineering rests, and to impart such special and technical knowledge of the various branches of engineering as will enable students to enter them and maintain themselves while gaining their professional experience. In addition, it is believed that the severe mental discipline of the various courses of instruction makes the engineering curriculum fully the equal of any other in general educational value.

## COURSES LEADING TO BACHELOR DEGREES

This college offers instruction in seven important fields of engineering work. Covering these the following four-year courses of study are offered:

1. Architecture, leading to the degree of Bachelor of Architecture, (B. Arch.)
2. Ceramic Engineering, leading to the degree of Bachelor of Ceramic Engineering, (B. Cr. E.)
3. Chemical Engineering, leading to the degree of Bachelor of Chemical Engineering, (B. Ch. E.)
4. Civil Engineering, leading to the degree of Bachelor of Civil Engineering, (B. C. E.)
5. Electrical Engineering, leading to the degree of Bachelor of Electrical Engineering, (B. E. E.)
6. Mechanical Engineering, leading to the degree of Bachelor of Mechanical Engineering, (B. M. E.)
7. Mine Engineering leading to the degree of Bachelor of Engineering in Mining, (B. E. M.)

These degrees will be conferred regularly for the first time in 1915. Students graduating before that time will receive degrees as published in prior issues of this bulletin, unless by special agreement between the faculty and students concerned.

## FIVE YEAR COURSE

For the benefit of those who are unable to carry the full schedule, on account of outside work for self-support, impaired health, or any other valid reason, any of the regular courses can be rearranged to cover five instead of four years.

## COMBINATION COURSES

It is also possible to arrange combination courses leading to two degrees (see page 32) in five or more years.

## GRADUATE COURSES

Advanced courses in various engineering subjects are offered, to those who wish to pursue them, by the Departments of the College of Engineering. If such courses are pursued with the expectation of receiving credit upon them to apply towards any higher degree, the student must register in the Graduate School, under whose jurisdiction all work for the higher degrees is conducted. For further information, consult the bulletin of the Graduate School of the University or confer with the Dean or Secretary.

## SHORT COURSES

The following two-year, or short courses, do not lead to a degree, but students completing them are furnished a formal certificate stating the work they have accomplished:

1. Clay-working.
2. Industrial Arts.
3. Mining.

The two-week course in Highway Engineering described on page 37 will probably be given again in 1914.

# CORPS OF INSTRUCTION

## EXECUTIVE

William Oxley Thompson, D. D., LL. D., President of the University.
Carl E. Steeb, B. Ph., Secretary of the Board of Trustees.
Edward Orton, Jr., E. M., Dean of the College of Engineering.
Edwin F. Coddington, C. E., Ph. D., Secretary of the College of Engineering.
Edith D. Cockins, B. A., Registrar.
Olive Branch Jones, B. A., Librarian.

## ARCHITECTURE

Joseph Nelson Bradford, M. E., Professor.
Charles St. John Chubb, Jr., C. E., (Arch.), Associate Professor.
Frank Hager Haskett, Instructor.
Albert Field, Student Assistant.

## ASTRONOMY

Henry Curwen Lord, B. Sc., Professor.
Edmund Sewell Manson, Jr., S. M., Associate Professor.

## CERAMIC ENGINEERING

Edward Orton, Jr., E. M., Professor.
Forrest Kiser Pence, B. A., Cer. E., Professor.
Homer Francis Staley, B. Sc., Professor.
Carl B. Harrop, E. M., Instructor,

## CHEMISTRY

William McPherson, D. Sc., Ph. D., Professor.
Sidney Augustus Norton, Ph. D., LL. D., Emeritus Professor.
William Edwards Henderson, Ph. D., Professor.
Charles William Foulk, B, A., Professor.
William Lloyd Evans, Ph. D., Professor.
James Renwick Withrow, Ph. D., Professor.
John Wilkinson, Ph. D., Assistant Professor.
Cecil Ernest Boord, Ph. D., Instructor.
Jesse Erwin Day, B. A., Assistant.
Elmer E. Hockett, B. A., Assistant.

HOMER DENISON HOLLER, B. A., Assistant.
GEORGE THOMAS CALDWELL, B. A., Assistant.
AND ELEVEN FELLOWS.

## CIVIL ENGINEERING

CHRISTOPHER ELIAS SHERMAN, C. E., Professor.
FRANK HARVEY ENO, B. S., C. E., Professor.
CLYDE TUCKER MORRIS, C. E., Professor.
ROY KARL SCHLAFLY, C. E., Assistant Professor.
THOMAS SLOAN HEWERDINE, C. E. Assistant Professor.
WILLIAM STANLEY HINDMAN, C. E. Instructor.
ROBERT NEIL WAID, C. E., Instructor.
RAY CARRUTH MCCALL, Assistant.

## ELECTRICAL ENGINEERING

FRANCIS CARY CALDWELL, B. A., M. E. in E. E., Professor.
ALAN ESTIS FLOWERS, M. E. in E. E., M. S., Professor.
JOHN ERNEST SHEPARDSON, B. S., Instructor.
ROY ATKINSON BROWN, M. E. in E. E., Instructor.
ROBERT MICKEY MOODY, M. E. in E. E. Assistant.

## ENGINEERING DRAWING

THOMAS EWING FRENCH, M. E., Professor.
ROBERT MEIKLEJOHN, M. E., Assistant Professor.
OWEN ETSEL WILLIAMS, Instructor.
ARTHUR C. HARPER, M. E., Instructor.
WILLIAM JAMES NORRIS, Instructor.
CREE SHEETS, C. E., (Arch.), Instructor.
FREDERICK W. IVES, B. S. in M. E., Instructor.
WILLIAM D. TURNBULL, C. E., Instructor.
EDWARD J. GILBERT, M. E., Instructor.
THEODORE H. PYLE, Student Assistant.

## ENGLISH

JOSEPH VILLIERS DENNEY, M. A., Professor.
GEORGE HARLEY MCKNIGHT, Ph. D., Professor.
WILLIAM LUCIUS GRAVES, M. A., Professor.
CARSON SAMUEL DUNCAN, Ph. D., Assistant Professor.
LOUIS ALBION COOPER, B. A., Assistant Professor.
HARRY FRANKLIN HARRINGTON, M. A., Assistant Professor.

EDWIN LONG BECK, M. A., Assistant Professor.
AND TWELVE FELLOWS

## GEOLOGY

CHARLES SMITH PROSSER, D. Sc., Ph. D., Professor.
JOHN ADAMS BOWNOCKER, D. Sc., Professor.
THOMAS MCDOUGAL HILLS, B. Ph., Assistant Professor.
WILLIAM CLIFFORD MORSE, M. A., Instructor.
AND TWO FELLOWS

## GERMAN

M. BLAKEMORE EVANS, Ph. D., Professor.
BERTHOLD AUGUST EISENLOHR, M. A., Professor.
MAY THOMAS, Ph. D., Assistant Professor.
SARAH TRACY BARROWS, M. L., Assistant Professor.
LUDWIG LEWISOHN, M. A., Assistant Professor.
ROBERT OSCAR BUSEY, M. A., Assistant Professor.
AND ONE FELLOW

## INDUSTRIAL ARTS

FRANK EDWIN SANBORN, S. B., Professor.
WILLIAM ABNER KNIGHT, M. E., Associate Professor.
CHARLES PHILIP CROWE, Instructor.
CLEMENT MEDARY BEEM, Instructor.
ALLANDO A. CASE, Instructor.
ULYSSES WALLACE DENMAN, Assistant.
JACOB ALLEN FOUST, Assistant.
JOHN JOSEPH BRECKUR, Assistant.
ROBERT ERNEST SMITH, Assistant.
HAROLD WRIGHT, Apprentice.
WINTHROP GLADWIN PLUMB, Student Assistant.

## MATHEMATICS

ROSSER DANIEL BOHANNAN, B. Sc., C. E., E. M., Professor.
GEORGE WASHINGTON MCCOARD, M. A., Professor.
KARL DALE SWARTZEL, M. Sc., Professor.
HARRY WALDO KUHN, Ph. D., Professor.
CHARLES LINCOLN ARNOLD, M. Sc., Associate Professor.
SAMUEL EUGENE RASOR, S. M., Associate Professor.
JOHN BOWKER PRESTON, M. A., Assistant Professor.
GRACE MARIE BAREIS, B. A., Assistant Professor.

CHARLES CLEMENT MORRIS, M. A., Assistant Professor.
CARL JOSEPH WEST, M. A., Assistant Professor.
HORTENSE RICKARD, B. A., Assistant.

## MECHANICAL ENGINEERING

WILLIAM THOMAS MAGRUDER, M. E., Professor.
*EMBURY ASBURY HITCHCOCK, M. E., Professor.
HORACE JUDD, M. E., M. Sc., Associate Professor.
ALEXANDER VALLANCE, M. E., Assistant Professor.
CORY C. MCCLELLAND, M. E., Assistant.
AUBREY INGERSON BROWN, Assistant.
GEORGE HERDMAN TAPPAN, A. B., M. E. in E. E., Student Assistant.

## MECHANICS

JAMES ELLSWORTH BOYD, M. S., Professor.
EDWIN F. CODDINGTON, C. E., Ph. D., Professor.
ROBERT HILL NEILAN, Student Assistant.

## METALLURGY AND MINERALOGY

EDWARD ELSWORTH SOMERMEIER, G. Ph., Professor.
DANA JAMES DEMOREST, B. Sc. (Chem.), Assistant Professor.
WILLIAM JOHN MCCAUGHEY, Ph. D., Assistant Professor.

## MILITARY SCIENCE AND TACTICS

GEORGE L. CONVERSE, U. S. A., (Ret.), Professor.

## MINE ENGINEERING

FRANK ARNOLD RAY, E. M., Professor.
WELLS HAMMOND MINOR, E. M., Assistant Professor.
IRA CALLENDER, Student Assistant.
WARNER STAFFORD, Student Assistant.

## PHYSICAL EDUCATION

H. SHINDLE WINGERT, M. D., Professor.

## PHYSICS

ALFRED DODGE COLE, A. M., Professor.
ROBERT FRANCIS EARHART, Ph. D., Professor.
FREDERIC COLUMBUS BLAKE, Ph. D., Professor.
SAMUEL JACKSON BARNETT, Ph. D., Professor.
CHARLES SHEARD, A. M., Assistant Professor.

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*Absent on leave 1912-1913.

ALPHEUS WILSON SMITH, Ph. D., Assistant Professor.
HERMAN GUSTAVUS HEIL, Ph. B., Instructor.
DWIGHT AUGUSTUS WOODBURY, A. M., Instructor.
GEORGE OLIVER WEIMER, M. E. in E. E., Assistant.
ALVA WELLINGTON SMITH, B. A., Assistant.
AND TWO FELLOWS

## ROMANCE LANGUAGES AND LITERATURES

BENJAMIN LESTER BOWEN, Ph. D., Professor.
CHARLES A. BRUCE, B. A., Professor.
EDGAR SHUGERT INGRAHAM, Ph. D., Assistant Professor.
THEODORE ELY HAMILTON, Ph. D., Assistant Professor.
ROBERT C. ROCKWOOD, B. A., Instructor.
GEORGE SCOTT CHAPIN, B. A., Instructor.
OTTO FERDINAND BOND, B. A., Instructor.

## ADMISSION

Applicants for admission must be at least seventeen years of age. The College is open on equal terms to both sexes.

### THE ENTRANCE BOARD

The admission of students to the University is in charge of the Entrance Board which determines the credit that shall be issued on all entrance examinations and certificates, and furnishes all desired information to applicants. Correspondence relating to admission should be addressed to the Entrance Board, Ohio State University Columbus.

### ADMISSION TO COURSES LEADING TO DEGREES

There are two modes of admission to courses leading to degrees: (a) by examination (b) by certificate.

### ADMISSION BY EXAMINATION

The Entrance Board will conduct entrance examinations June 3 to 8, and September 9 to 13, 1913. Part of the examinations may be taken in June and the remainder in September. All applicants for admission who do not possess certificates covering entrance requirements must take examinations for admission.

SCHEDULE OF EXAMINATIONS. The hours for examinations are 8 A. M. and 1 P. M. Students intending to take any of examinations scheduled in any given half day must appear within one hour of the time set for the examination. Students applying for examination will first go to the office of the Entrance Board, 100 University Hall, for registration.

| | | |
|---|---|---|
| Tuesday | A. M. | History: Ancient and Medieval (to 814 A. D.), Medieval and Modern (after 814 A. D.), English. |
| " | P. M. | English Composition and Rhetoric, English Classics, Chemistry. |
| Wednesday | A. M. | Algebra, Physical Geography, Greek. |
| " | P. M. | Plane Geometry, German, Spanish. |
| Thursday | A. M. | Civil Goverment, Solid Geometry, Zoölogy. |
| " | P. M. | Beginning Latin and Cæsar, Elements of Agriculture, Trigonometry, Commercial Geography. |

| | | |
|---|---|---|
| Friday | A. M. | Physics, Physiology, Botany. |
| " | P. M. | American History, French, English Literature. |
| Saturday | A. M. | Vergil, Cicero, Domestic Science. |

A special bulletin of Entrance Information will be mailed on request. Address The University Editor.

## ADMISSION BY CERTIFICATE

Applicants may be admitted without examination on presentation of properly endorsed certificates from such secondary schools as have been accredited or recognized by the University, or from approved normal schools, or from the State Board of School Examiners under the following provisions:

(a) If from secondary schools, the cerificate must show that the applicant is a graduate in good standing of the school issuing it; and also must state in detail the studies pursued, the text books used, the amount of work done in each study, the amount of time devoted to it, and the fact that the applicant has passed in the work.

(b) Any entrance requirement not covered by a certificate must be met by examination.

Blank certificates may be obtained by addressing the Secretary of the Entrance Board. Certificates should be filled out by the proper official and returned to the University as early as possible after the close of schools in June.

## REQUIREMENTS BY UNITS

To obtain full standing in the College of Engineering, applicants under twenty-one years of age must have credit by examination or certificate for fifteen units. A unit is the equivalent of a course of study covering a school year, during which one hundred and twenty clock-hours are devoted to class-room work on the study. Two hours in the laboratory are equivalent to one hour in the class-room.

Of these fifteen units, not less than three shall be English, one, history; three, mathematics (including solid geometry); one, physics; four, languages (other than English); and the balance shall be elective. The fifteen units shall be selected from the following list. A study listed as a half unit will be counted merely as such even if the course has extended for more than a half year. A study listed as one-half or one unit will be given either rating, depending upon the length of the course. On a study listed as one unit, no credit will be given for less than a year's work. In foreign language no credit will be given for less than two units.

In foreign languages, six units are required in the preparatory school and college combined. These six units may be done wholly in the preparatory school, or partly in the preparatory school and partly in college, in which case at least two units must be done in college, or under some circumstances the entire six units may be done in college. They may be taken in any one of the three modern languages or any combination of the five ancient and modern languages, offered below, provided that not less than two units of any single language be offered.

| | |
|---|---|
| English (Foreign students may substitute their native language for the English requirement.) | 1, 2, 3, or 4 units |
| American History or American History and Civil Government | 1 unit |
| Ancient History (Greek and Roman) and Medieval History to 814 A. D. | 1 unit |
| Medieval and Modern History (from 814 A. D. to the present) (for the present General History may be counted as a unit, but not in addition to Ancient or Medieval and Modern History.) | 1 unit |
| English History | 1 unit |
| Algebra (through quadratics) | 1 unit |
| Algebra (beyond quadratics) | ½ unit |
| Geometry (plane) | 1 unit |
| Geometry (solid) | ½ unit |
| Trigonometry | ½ unit |
| Latin | 2, 3, or 4 units |
| Greek | 2 or 3 units |
| German | 2, 3, or 4 units |
| French | 2, 3, or 4 units |
| Spanish | 2, 3, or 4 units |
| Physics | 1 unit |
| Chemistry | 1 unit |
| Physical Geography | 1 unit |
| Zoölogy | 1 unit |
| Botany | 1 unit |

| | | |
|---|---|---|
| Physical Geography<br>Zoölogy<br>Botany<br>Physiology<br>Agriculture | For the present any two of these may be counted together as | 1 unit |
| *Free-hand drawing<br>Manual Training<br>Domestic Science<br>Commercial Geography | The Entrance Board may, after investigating each claim, grant a total credit of not to exceed | 2 units |

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*Students expecting to enter the College of Engineering are advised to take free-hand drawing in high school.

No student under twenty-one years of age will be admitted to college if he is conditioned in more than two of the fifteen units. An applicant twenty-one years of age or over may be admitted with a total deficiency of four units. Of these four units, all may be in foreign language, but not more than two units may be in subjects other than foreign language.

Students over twenty-one years of age may also be admitted as special students in accordance with the provisions stated under "Admission to Special Studies."

The extent and character of the work required in each subject mentioned above is explained in a special bulletin entitled "Definitions of Entrance Units," which will be sent by the University Editor to any address, upon request.

## REMOVAL OF ENTRANCE CONDITIONS

The removal of entrance conditions is administered by the Entrance Board. Conditions may be removed (1) by examination or (2) by the substitution of excess work in other approved subjects, or (3) by the substitution of other equivalent work to be done at the University. All entrance conditions must be removed within two years after admission. If, at the end of the first year, a student still has entrance conditions outstanding, the Secretary of the College will assign such college courses as may be deemed a fair equivalent for the work in which the student has entrance conditions. A condition in physics must be removed before entering on the work of the second year. (See also statement on page 13 on foreign languages.)

## ADMISSION WITH ADVANCED STANDING

Applicants who have completed at least one year's work of collegiate rank in an approved college, and who bring official and explicit certificates describing their course of study and scholarship, and letters of honorable dismissal, will be admitted in accordance with either of two plans:

(1) The entrance units on which the candidate was admitted to the approved college will be accepted at their face value; deficiencies will be made up from the college credits presented, and advanced credit will be given for any remaining satisfactory work; or

(2) One year's work will be accepted in lieu of entrance units and the candidate will be admitted without examination and without conditions, but without any advanced standing on the year's work.

Applicants who have completed less than one year's work in an approved college must satisfy the entrance requirements in the usual way, and will then be given credit for any satisfactory work for which they can offer certificates.

## ADMISSION TO SPECIAL STUDIES

Students who desire to pursue special lines of work in the University, and do not intend to become candidates for degrees, will be admitted on the following conditions.

1. If the applicant can satisfy the entrance requirements, he must send to the Entrance Board for reference to the Executive Committee of the Engineering College a complete statement of the course which he wishes to take, together with his reasons for desiring this course and a detailed statement of his practical experience in engineering.

2. If he can not satisfy the entrance requirements but is at least twenty-one years of age, he *may* be admitted by the joint action of the Entrance Board and the Executive Committee of the Engineering College, provided he passes the entrance examination in alegbra and plane geometry. Such a student must send a full statement of the course he wishes to pursue, his practical experience in engineering, and certificates from his employers giving the nature and duration of his experience.

3. Permission to enter as special undergraduates will be refused to all who fail to give satisfactory evidence of definiteness of purpose and will be withdrawn whenever the conditions on which it was granted cease to exist.

## ADMISSION TO THE SHORT COURSES

Applicants must be at least seventeen years of age and, unless they are over twenty-one years of age, must pass examinations in arithmetic and geography. and must be able to write a business letter or a short theme, correct in grammar and orthography; or they must present satisfactory certificates showing that they have succesfully pursued these subjects elsewhere. In addition, each applicant under twenty-one years of age must present a letter or certificate showing that he has at least two years' consecutive practical experience in some industry related to the course which he wishes to pursue, and this certificate must be satisfactory to the Executive Committee of the College of Engineering.

Applicants over twenty-one years of age are admitted without examination, but must present a letter or certificate covering practical experience, as provided in the case of those less than twenty-one years of age.

# COURSES OF STUDY

## OUTLINE OF THE FIRST YEAR'S WORK OF ALL FOUR-YEAR COURSES

In order to permit all engineering students to have a year in which to ascertain their tastes more fully and find out definitely what courses they desire to pursue, the first year of all engineering courses is made uniform. While students are asked to indicate their choice of courses on entering the college, they can change at the end of the first year without any inconvenience.

Note—The figure in parenthesis following the name of each study indicates the number of the study in its department; the other figure indicates the number of credit hours.

| First Semester | | | Second Semester | | |
|---|---|---|---|---|---|
| Mathematics<br>College Algebra and Trig. | (131) | 5. | Mathematics<br>Trig. and Analytics. | (132) | 5. |
| Chemistry<br>General Chemistry. | (105 or 109)* | 4. | Chemistry<br>General Chemistry and Qualitative Analysis. | (106 or 110)* | 4. |
| Modern Language<br>French, Ger., or Span. | | 4. | Modern Language<br>French, Ger., or Span. | | 4. |
| English<br>Paragraph Writing. | (101) | 2. | English<br>Paragraph Writing. | (104) | 2. |
| Engineering Drawing<br>Elementary Mechanical. | (101) | 2. | Engineering Drawing<br>Lettering and Projections. | (102) | 3. |
| Military Drill | | 1. | Military Drill | | 1. |
| Gymnasium | | 1. | Gymnasium | | 1. |

*Students presenting Chemistry as an entrance subject will take Chemistry 109 and 110. Students with no entrance credits in Chemistry will take Chemistry 105 and 106.

## SUMMER SESSION

Shop Work is required in the Summer Session in all Engineering courses except Architecture and Civil Engineering. In the courses in Electrical, Mechanical, and Mine Engineering, the shopwork courses (109) and (115) are required at the end of the first year. In the course in Chemical Engineering, the same courses are required, but may be taken at the end of the first or second year. In the course in Ceramic Engineering, the three courses (107), (109), and (115) are offered and two of these must be taken at the end of the first year.

## ARCHITECTURE

The special architectural work of the course commences in the second year with history of architecture which affords instruction in the principles governing design in classic, medieval and renaissance work, and the proper use to be made of precedent. The history of architecture is accompanied by a course in drawing and design devoted to the "order problems." Courses involving class and drawing room work are given during this year in shades and shadows, and architectural perspective.

Throughout the third and fourth years practical designing courses are given, which include problems relating to residences, apartment houses, school buildings, public buildings, tall, steel framed office buildings, and ecclesiastical structures. Decoration, architectural composition, working drawings, and structural details are covered in separate courses during the third year, while monumental design, specifications, estimating, sanitary plumbing, and professional practise are studied in the fourth year.

Drawing, both free hand and mechanical, is very essential to the architect. Thus, in addition to the extensive practice which the student gets in his designing, a series of courses in drawing and allied subjects run through the four years.

On the structural side courses are given in trusses, cement work, masonry, steel construction, reinforced concrete, and surveying. Work in the testing of materials and in heating and ventilating is also given. A thesis, usually the complete plans and specifications for some important structure, is required before graduation.

A special bulletin describing more fully the work of this department will be mailed on request. Address the University Editor.

## COURSE IN ARCHITECTURE

FOR FIRST YEAR, SEE PAGE 17

### SECOND YEAR

| First Semester | | | Second Semester | | |
|---|---|---|---|---|---|
| Mathematics<br>Calculus | (141) | 5. | Mathematics<br>Calculus. | (142) | 5. |
| Engineering Drawing<br>Charcoal from Ornament. | (115) | 2. | Engineering Drawing<br>Pen Drawing. | (116) | 2. |
| Architecture<br>History of Architecture. | (101) | 3. | Architecture<br>History of Architecture. | (102) | 3. |
| Architecture<br>Order Problems. | (103) | 2. | Architecture.<br>Order Problems. | (104) | 5. |
| Engineering Drawing<br>Descriptive Geometry. | (107) | 3. | Architecture<br>Shades, Shadows and Perspective. | (124) | 3. |
| Physics<br>General Physics. | (111) | 3. | | | |
| Military Drill | | 1. | Military Drill | | 1. |

Summer Course—Architecture (120), Architectural Practise, or an Architectural Problem. 4 credit hours.

### THIRD YEAR

| First Semester | | | Second Semester | | |
|---|---|---|---|---|---|
| Mechanics<br>Statics and Str. of Materials. | (101) | 5. | Mechanics<br>Strength of Materials. | (104) | 2. |
| Engineering Drawing<br>Water Color. | (117) | 3. | Engineering Drawing<br>Charcoal from Antique. | (118) | 3. |
| Architecture<br>Design. | (107) | 5. | Architecture<br>Design. | (108) | 4. |
| Architecture<br>Decoration, etc. | (109) | 3. | Architecture<br>Working Drawings. | (110) | 4. |
| Architecture<br>Arch. Composition. | (113) | 2. | Architecture<br>Photography. | (112) | 2. |
| | | | Civil Engineering<br>Trusses. | (124) | 3. |

Summer Course—Architecture (121), Architectural Practise, of an Architectural Problem. 4 credit hours.

### FOURTH YEAR

| First Semester | | | Second Semester | | |
|---|---|---|---|---|---|
| Architecture<br>Design. | (115) | 6. | Architecture<br>Design. | (114) | 3. |
| Architecture<br>Plumbing. | (117) | 1. | Architecture<br>Professional Practice. | (116) | 4. |
| Architecture<br>Masonry. | (119) | 2. | Civil Engineering<br>Surveying. | (128) | 2. |
| Civil Engineering<br>Tall Buildings. | (125) | 3. | Civil Engineering<br>Cement and Concrete. | (118) | 3. |
| Mechanical Eng.<br>Materials of Const. | (123) | 2. | Architecture<br>Thesis. | (118) | 5. |
| Mechanical Eng.<br>Heating and Ventilating. | (121) | 2. | | | |
| Engineering Drawing<br>Clay Modeling. | (119) | 2. | | | |

## CERAMIC ENGINEERING

Ceramic Engineering is the application of Chemistry and Engineering to a well defined group of non-metallic mineral industries, viz., clayworking, glass manufacture and cement manufacture. These industries all manufacture silicate products and employ the same raw material to a large extent, and thus constitute a natural division of chemical technology.

The ceramic engineer should be something of a geologist and mining engineer in order to discover and work his raw material. He should be a mechanical engineer to prepare these materials and manufacture them into the required shape, and he must be a chemist to understand what takes place in kilns and furnaces. His course, while founded upon chemical technology, must still be broad and varied and include a liberal amount of general engineering.

The technical work in ceramic engineering begins in the second year with a laboratory course running through the year, dealing with the chemical analysis of the various materials used in ceramic industries. During the last semester this is accompanied by a course in ceramic calculations. In the third year this work is continued by a course of lectures through the year, which cover the winning of the raw materials, their preparation and manufacture, and the drying, burning, and decoration of the ceramic products. In the fourth year, laboratory courses on the manufacture of ceramic bodies, the production of glazes, and the production of enamels and colors continue the ceramic training. However, a course on cement manufacture may be elected in place of the course on enamels and colors. In this year there is also a course on the drawing and design of ceramic structures. The ceramic subjects constitute about 35 per cent of the total work required for the degree.

## COURSE IN CERAMIC ENGINEERING

FOR FIRST YEAR, SEE PAGE 17

### SECOND YEAR

| First Semester | | | Second Semester | | |
|---|---|---|---|---|---|
| Mathematics<br>Calculus. | (141) | 5. | Mathematics<br>Calculus. | (142) | 5. |
| Physics<br>Mechanics and Heat. | (113) | 5. | Physics<br>Elec. Light and Sound. | (114) | 5. |
| Engineering Drawing<br>Descriptive Geometry. | (103) | 3. | Engineering Drawing<br>Machine Sketching. | (104) | 3. |
| Ceramic Engineering<br>Ceramic Chemistry. | (101) | 5. | Ceramic Engineering<br>Laboratory. | (102) | 3. |
| | | | Ceramic Engineering<br>Ceramic Calculations. | (106) | 2. |
| Military Drill | | 1. | Military Drill | | 1. |

### THIRD YEAR

| | | | | | |
|---|---|---|---|---|---|
| Mechanics<br>Statics and Str. Materials. | (101) | 5. | Mechanics<br>Strength of Materials. | (104) | 2. |
| Chemistry<br>Physical Chemistry. | (157) | 3. | Chemistry<br>Physical Chemistry. | (158) | 3. |
| Mine Engineering<br>Mine Surveying. | (103) | 4. | Civil Eng.<br>Trusses. | (124) | 3. |
| Ceramic Engineering<br>Ceramic Manufacture. | (103) | 5. | Ceramic Engineering<br>Ceramic Manufacture. | (104) | 5. |
| Mine Engineering<br>Mine Trip. | (109) | 1. | Ceramic Engineering<br>Phys. Chem. Measurements. | (108) | 3. |
| | | | Ceramic Engineering<br>Glazes Colors. | (110) | 2. |

### FOURTH YEAR

| | | | | | |
|---|---|---|---|---|---|
| Ceramic Engineering<br>Laboratory. | (111) | 5. | *Ceramic Engineering<br>Laboratory | (112) | 5. |
| Ceramic Engineerng<br>Drawing | (113) | 2. | Ceramic Engineering<br>Drawing. | (114) | 3. |
| Mechanical Eng.<br>Laboratory and Lecture. | (171) | 4. | *Ceramic Engineering<br>Cement Lectures. | (118) | 5. |
| Geology<br>General Geology | (165) | 3. | Civil Engineering<br>Cement and Concrete. | (118) | 3. |
| Metallurgy<br>Gen. Metallurgy. | (109) | 4. | Mechanical Eng.<br>Mechanism and Design | (110) | 3. |
| | | | Ceramic Engineering<br>Thesis. | (116) | 4. |

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*Alternative courses. One must be taken.

## CHEMICAL ENGINEERING

The course in Chemical Engineering has been prepared to meet the growing demands for trained men in the numerous industries which employ chemical processes prominently in their work, and which are not included in the fields of metallurgy and ceramics. Among such may be mentioned the manufacture of acids, alkalies, salts, paints, dyes, soaps, glue, starch, sugar, preservatives, antiseptics, fertilizers, and others.

This course differs from the ordinary course in Chemistry in that it is extended greatly along engineering lines. There are four full years' work in consecutive chemical courses; elementary chemistry and qualitative analysis in the first year; advanced chemistry and quantitative analysis in the second, organic chemistry in the third, and physical and industrial chemistry in the fourth. In addition there are several smaller elective courses in chemistry, which the student may elect, and further chemical applications are given in metallurgy, assaying and mineralogy in another department.

In the engineering line, beside the usual fundamental work in mathematics, physics, mechanics and drawing, four weeks each of carpentry and forging is given in the first summer, a course in technical drawing, dealing chiefly, with chemical machinery in the third year. This leads up to a course in machine design in the fourth year. There are also courses in power plants, and electrical machinery.

In addition to the elective work offered in the fourth year, three hours must be devoted to the preparation of a thesis. A special bulletin describing this department will be mailed upon request. Address the University Editor.

## COURSE IN CHEMICAL ENGINEERING

FOR FIRST YEAR, SEE PAGE 17

### SECOND YEAR

| First Semester | | | Second Semester | | |
|---|---|---|---|---|---|
| Mathematics<br>Calculus. | (141) | 5. | Mathematics<br>Calculus. | (142) | 5. |
| Physics<br>Gen. Physics. | (111) | 3. | Physics<br>Gen. Physics. | (112) | 3. |
| Engineering Drawing<br>Descriptive Geometry. | (103) | 3. | Engineering Drawing<br>Machine Sketching. | (104) | 3. |
| Chemistry<br>Quantitative Analysis. | (119) | 4. | Chemistry<br>Quantitative Analysis. | (120) | 4 |
| Chemistry<br>Adv. Gen. Chemistry. | (113) | 2. | Chemistry<br>Adv. Gen. Chemistry. | (114) | 2. |
| | | | Chemistry<br>Chemical Problem. | (124) | 1. |
| Military Drill | | 1. | Military Drill | | 1. |

### THIRD YEAR

| | | | | | |
|---|---|---|---|---|---|
| Mechanics<br>Statics and Str. Matr'ls. | (101) | 5. | Mechanics<br>Kinetics and Hydraulics. | (102) | 5. |
| Engineering Drawing<br>Technical Drawing | (121) | 2. | Engineering Drawing<br>Technical Drawing. | (122) | 2. |
| Metallurgy<br>Gen. Metallurgy. | (109) | 4. | Metallurgy<br>Mineralogy and Cryst'g'phy. | (104) | 3. |
| Chemistry<br>Organic Chem., lec. | (151) | 2. | Chemistry<br>Organic Chem., lec. | (152) | 2. |
| Chemistry<br>Organic Chem., lab. | (153) | 2. | Electives<br>(See foot note.) | | 5 to 7 |
| Mechanical Eng.<br>Steam Power Plants. | (103) | 3. | | | |

### FOURTH YEAR

| | | | | | |
|---|---|---|---|---|---|
| Mechanical Eng.<br>Machine Design. | (127) | 5. | Mechanical Eng.<br>Machine Design. | (144) | 5 |
| Chemistry<br>Physical Chemistry. | (157) | 3. | Chemistry<br>Physical Chemistry. | (158) | 3. |
| Chemistry<br>Industrial Chemistry. | (177) | 2. | Chemistry<br>Industrial Chemistry. | (178) | 1. |
| Chemistry<br>Indust. Chem. lab. | (185) | 2. | Chemistry<br>Indust. Chem. Lab. | (186) | 3. |
| Electrical Eng.<br>Elementary Elec. Eng. | (101) | 5. | Chemistry<br>Thesis. | (140) | 4. |
| | | | Chemistry<br>(Elective) | (182 or 184) | 1.<br>2. |

Electives in third year, second semester, must be chosen from the following courses, subject to approval of the departments concerned: Chemistry (136) 2, Chemical Literature; Chemistry (154) 2 or 3, Advanced Organic Chemistry; Chemistry (168) 3 to 5, Advanced Qualitative Analysis; Chemistry (176) 3, Sanitary Analysis; Chemistry (188) 2 or 3, Inorganic Preparations; Metallurgy (110) 4, General Metallurgy; Metallurgy (112) 2, Calorimetry and Mine Gas Analysis.

## CIVIL ENGINEERING

Among the special fields which are usually included under the title of civil engineering are those of the design, construction, and maintenance of bridges, railroads, municipal water supply, sewers, street paving, road building and other public works, irrigation projects, and river and harbor improvements. The civil engineer also superintends topographic and geodetic surveys and does other special lines of work.

The course of instruction is designed to provide the foundation upon which all of these specialties are built.

The technical work begins in the second year with courses in land and railroad surveying, accompanied by practice in the field, and by class-room work topographic drawing. In the third year are courses in topographic surveying, a drawing room course in timber construction and in stereotomy, a lecture and laboratory course in cement testing, and class-room courses in roads and streets, bridge stresses, and sanitary engineering. In the fourth year are given courses in bridge design, masonry structures, and reinforced concrete; also class-room courses in masonry construction, water suppy engineering, and contracts and specifications. There is also an opportunity to select between a course in advanced bridge designing and one in railway location.

Distributed through the third and fourth years are courses in the applications of electrical machinery, least squares, astronomy, photography, water pumps and motors, tesfing of materials of construction, calibrations of weirs, and general geology. Most of these courses include laboratory practice. In each of the summers following the second and third years, four weeks of field practise in surveying is required, and before graduation, a thesis giving results of some original work along civil engineering lines.

A special bulletin describing this department will be mailed on request. Address the University Editor.

## COURSE IN CIVIL ENGINEERING

FOR FIRST YEAR, SEE PAGE 17

### SECOND YEAR

| First Semester | | | Second Semester | | |
|---|---|---|---|---|---|
| Mathematics<br>Calculus. | (141) | 5. | Mathematics<br>Calculus. | (142) | 5. |
| Physics<br>Gen. Physics. | (111) | 3. | Physics<br>Gen. Physics. | (112) | 3. |
| Engineering Drawing<br>Descriptive Geometry. | (105) | 3. | Engineering Drawing<br>Advanced Descriptive Geom. | (106) | 3. |
| Civil Eng.<br>Land Surveying and Field Practise | (101 and 101a) | 4 & 1 | Civil Eng.<br>R. R. Surveying and Field practise | (102 and 102a) | 3 & 1 |
| Civil Engineering<br>Topographic Drawing. | (103) | 2. | Geology<br>Gen. Geology. | (168) | 3. |
| Military Drill | | 1. | Military Drill | | 1. |

Summer Courses—Civil Engineering (104 and 111), each four weeks of six days per week. Four credit hours for each course. Field work in Surveying. Required in second and third years respectively.

### THIRD YEAR

| First Semester | | | Second Semester | | |
|---|---|---|---|---|---|
| Mechanics<br>Statics and Str. of Mater'ls. | (101) | 5. | Mechanics<br>Kinetics and Hydraulics. | (102) | 5. |
| Civil Engineering<br>Topographic Surveying. | (105) | 3. | Civil Engineering<br>Timber Construction. | (108) | 3. |
| Civil Engineering<br>Stereotomy. | (107) | 3. | Civil Engineering<br>Roads and Streets. | (106) | 3. |
| Civil Engineering<br>Sanitary Eng. | (109) | 2. | Civil Engineering<br>Stresses in Structures. | (110) | 4. |
| Electrical Eng.<br>Elementary Eng. | (103) | 3. | Astronomy<br>Geodesy and Least Squares. | (104) | 3. |
| Architecture<br>Photography. | (111) | 2. | | | |

### FOURTH YEAR

| First Semester | | | Second Semester | | |
|---|---|---|---|---|---|
| Civil Engineering<br>Bridge Design. | (113) | 4. | *Civil Engineering<br>Adv. Bridges. | (114) | 4. |
| Civil Engineering<br>Water Supply | (117) | 3. | *Civil Engineering<br>Railways. | (112) | 4. |
| Civil Engineering<br>Masonry Construction. | (115) | 3. | Civil Engineering<br>Masonry Structures. | (116) | 3. |
| Astronomy<br>Geodesy and Least Squares. | (105) | 3. | Civil Engineering<br>Cement and Concrete. | (118) | 3. |
| Mechanical Eng.<br>Laboratory. | (173) | 5. | Civil Engineering<br>Contracts and Spec. | (120) | 2. |
| Civil Engineering<br>Thesis. | (119) | 1. | Mechanical Eng.<br>Mechanism and Mach. Des. | (140) | 2. |
| | | | Civil Engineering<br>Thesis. | (122) | 4. |

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*Alternative Course. One must be taken.

## ELECTRICAL ENGINEERING

While there are few industries into which the application of electricity does not enter, there are several, such as electric railways, lighting and power, telephony and telegraphy, railroad signaling, shop drive, etc., and the manufacture of the corresponding forms of apparatus, which call especially for an electro-technical training.

Electricity and magnetism naturally constitute the most important studies of this course. This work begins in the second year in the physics department: in the third year it occupies nearly half of the time, and includes electrical measurements, direct current dynamo machinery, and a general course covering the applications of electricity in the first semester, and an introduction to alternating current apparatus in the second. In all of this work the laboratory plays an important part in the fourth year; the study of alternating current apparatus in class room and dynamo laboratory runs throughout the year. The design of dynamo machines runs through this year. Short courses are also given in electrical applications, transmission, railways, telephones, illumination, and wireless telegraphy.

Besides the work of first and second years, practise in drawing is obtained in the design work of the third and fourth years. Work in carpentry, forging, and the machine shop occupies four weeks of continuous time in the first summer and continues during the second year. The successful electrical engineer must be a good mechanical engineer. Thus, courses in mechanism, mechanical laboratory, power plants, engines and boilers, and machine design are distributed over the last two years. There are also some electives in the fourth year.

An important feature is the two inspection trips which are required in the junior and senior years. Special bulletin describing this department will be mailed on request. Address the University Editor.

## COURSE IN ELECTRICAL ENGINEERING

FOR FIRST YEAR, SEE PAGE 17

### SECOND YEAR

| First Semester | | | Second Semester | | |
|---|---|---|---|---|---|
| Mathematics<br>Calculus. | (141) | 5. | Mathematics<br>Calculus. | (142) | 5. |
| Physics<br>Mechanics and Heat. | (113) | 5. | Physics<br>Elec. Light and Sound. | (114) | 5. |
| Engineering Drawing<br>Descriptive Geometry. | (103) | 3. | Physics<br>Laboratory | (134) | 3. |
| Physics<br>Laboratory. | (133) | 2. | Engineering Drawing<br>Machine Sketching | (110) | 2. |
| Shopwork<br>Machine Work. | (119) | 3. | Shopwork<br>Adv. Machine Work. | (122) | 3. |
| Military Drill | | 1. | Military Drill | | 1. |

### THIRD YEAR

| | | | | | |
|---|---|---|---|---|---|
| Mechanics<br>Statics and Str. of Materials. | (101) | 5. | Mechanics<br>Kinetics and Hydraulics. | (102) | 5. |
| Physics<br>Laboratory | (135) | 5. | Electrical Eng.<br>D. C. Machinery. | (104) | 5. |
| Mechanical Eng.<br>Steam Power Plants. | (103) | 3. | Mechanical Eng.<br>Steam Engines. | (118) | 3. |
| Mechanical Eng.<br>Mechanism. | (101) | 3. | Mechanical Eng.<br>Laboratory. | (160) | 2. |
| Engineering Drawing<br>Technical. | (111) | 2. | Electrical Eng.<br>Applications A. C. Prin. | (106 & 108) | 3. |
| | | | Electrical Eng.<br>Inspection Trip. | (130) or (134) | |

### FOURTH YEAR

| | | | | | |
|---|---|---|---|---|---|
| Mechanical Eng.<br>Laboratory. | (175) | 3. | Electrical Eng.<br>A. C. Laboratory. | (112) | 3. |
| Electrical Eng.<br>A. C. Laboratory. | (111) | 3. | Electrical Eng.<br>Transmission. | (124) | 3. |
| Electrical Eng.<br>A. C. Machinery. | (109) | 3. | Industrial Arts<br>Machine Design. | (112) | 2. |
| Electrical Eng.<br>Elec. Machine Design. | (121) | 3. | Electrical Eng.<br>Inspection Trip. | (130 or 134) | |
| Electrical Eng.<br>Thesis. | (127) | 1. | Electrical Eng.<br>Thesis. | (128) | 5. |
| Electrical Engineering | (*) | 2. | | | |
| Elective | | 2 to 4. | Elective | | 2 to 5. |

*One of the following: (113) Railways, (115) Telephones, (117) Illumination, (119) Wireless Telegraphy.

## MECHANICAL ENGINEERING

Mechanical engineering in its broadest meaning includes the invention, development, design, manufacture, and operation of all forms of machinery.

Apart from drawing and shopwork, the technical work in mechanical engineering begins in the first semester of the third year, with a descriptive course on power plants and followed by a more advanced course in steam engineering, accompanied by laboratory work and recitations and drawing practice in the principles of mechanism and mechanical movements. In the fourth year the steam engineering work is continued, with courses on gas engines and thermodynamics. A laboratory course runs throughout the fourth year, and covers the testing of materials of construction, steam, hot-air, and gas engines, power transmission, boilers, and injectors, air compressors, pumps and other hydraulic apparatus. The course in machine design runs through the year with lectures, recitations, and drawing-room practise in the applications. Courses on hydraulic machinery, and upon shop appliances and steam turbines, complete the list of mechanical engineering subjects.

Allied courses are given in the chemistry of fuels, the metallurgy of iron and steel, in timber and masonry constructions, the design of trusses, in differential equations, machinery and photography.

The two inspection trips, which are required in the junior and senior years, are an imporant feature. A thesis, giving the results of a piece of original work is required. A special bulletin describing this department will be mailed on request. Address the University Editor.

## COURSE IN MECHANICAL ENGINEERING

FOR FIRST YEAR SEE PAGE 17.

### SECOND YEAR

| FIRST SEMESTER | | | SECOND SEMESTER | | |
|---|---|---|---|---|---|
| Mathematics<br>Calculus | (141) | 3. | Mathematics<br>Calculus. | (142) | 5. |
| Physics<br>Mechanics and Heat | (113) | 5. | Physics<br>Electricity and Light. | (112) | 3. |
| Engineering Drawing<br>Descriptive Geometry | (103) | 3. | Engineering Drawing<br>Machine Sketching. | (104) | 3. |
| Shopwork<br>Foundry, | (105) | 2. | Shopwork<br>Machine Work. | (120) | 3. |
| Shopwork<br>Chipping and Filing | (107) | 2. | Physics<br>Laboratory. | (138) | 2. |
| Shopwork<br>Adv. Pattern Making. | (111) | 1. | Civil Engineering<br>Surveying. | (128) | 2. |
| Military Drill | | 1. | Military Drill | | 1. |

### THIRD YEAR

| | | | | | |
|---|---|---|---|---|---|
| Mechanics<br>Statics and Str. of Materials. | (105) | 5. | Mechanics<br>Kinetics and Hydraulics. | (102) | 5. |
| Engineering Drawing<br>Technical Drawing | (111) | 2. | Architecture<br>Photography. | (112) | 2. |
| Metallurgy<br>General Metallurgy. | (109) | 4. | Civil Engineering<br>Timber and Masonry. | (126) | 2. |
| Mathematics<br>Diff. Equations. | (151) | 1. | Mech. Eng.<br>Mechanism and Drawing. | (114 and 116) | 3&1. |
| Shopwork<br>Adv. Machine Work. | (121) | 3. | Mech. Eng.<br>Steam Engines and Boilers. | (118 & 120) | 3&1. |
| Mechanical Eng.<br>Steam Power Plants. | (103) | 3. | Mechanical Eng.<br>Laboratory. | (164) | 2. |
| | | | Mechanical Eng.<br>Inspection Trip. | (130 or 134) | |

### FOURTH YEAR

| | | | | | |
|---|---|---|---|---|---|
| Civil Engineering<br>Trusses. | (123) | 3. | *Industrial Arts<br>Shop Buildings. | (114) | 2. |
| Electrical Eng.<br>Elementary Elec. Eng. | (101) | 5. | *Mechanical Eng.<br>Steam Turbines. | (146) | 2. |
| Mechanical Eng.<br>Machine Design. | (127) | 5. | Mechanical Eng.<br>Machine Design | (144) | 5. |
| Mechanical Eng.<br>Gas Engines and Producers. | (125) | 2. | Mechanical Eng.<br>Hydraulic Machinery. | (142) | 2. |
| Mechanical Eng.<br>Thermodynamics. | (129) | 2. | Mechanical Eng.<br>Laboratory. | (190) | 6. |
| Mechanical Eng.<br>Laboratory. | (179) | 2. | Mechanical Eng.<br>Thesis. | (148) | 3. |
| | | | Mechanical Eng.<br>Inspection Trip. | (130 or 134) | |

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Alternative Courses. One must be taken.

## MINE ENGINEERING

The professor of mine engineering, which has for its main object the development and winning of mineral resources, is closely connected with that of metallurgy.

The special work in mine engineering proper begins in the second year with mine surveying in which, in addition to the instruction at the University, practice is given in actual surveying of coal mines accessible to Columbus. In the fourth year a course of lectures treats of the problems of mine engineering involved in opening, developing and equipping mining plants, and the prospecting, location and examination of mineral property and mining plants.

The special work in metallurgy begins in the second semester of the second year and comprises courses in the metallurgical laboratory, and one semester in mineralogy and crystallography. In the third year a course of lectures for both semesters treats of the principles of combustion, the valuation and the treatment of fuels, and the extraction and preparation of iron, steel, and other metals, including gold and silver. There is also work in advanced metallurgical laboratory, where special analytical methods, coal washing and ore dressing are studied by lectures and laboratory practice, also calorimetry and the microscopic examination of metals. In this year there is a one-semester course in determinative mineralogy and a one-semester laboratory course in the fire assaying of gold, silver, and other ores. In the fourth year there is a course in connection with the department of mine engineering on metallurgical construction covering the design of furnaces and other metallurgical machinery, and a course of lectures on ore dressing and coal washing.

## COURSE IN MINE ENGINEERING

FOR FIRST YEAR, SEE PAGE 17

### SECOND YEAR

| First Semester | | | Second Semester | | |
|---|---|---|---|---|---|
| Mathematics<br>Calculus. | (141) | 5. | Mathematics<br>Calculus. | (142) | 5. |
| Physics<br>General Physics. | (111) | 3. | Physics<br>General Physics. | (112) | 3. |
| Engineering Drawing<br>Descriptive Geometry. | (103) | 3. | Engineering Drawing<br>Machine Sketching. | (104) | 3. |
| Chemistry<br>Quantitative Analysis. | (119) | 3. | Metallurgy<br>Laboratory. | (106) | 4. |
| Mine Engineering<br>Mine Surveying. | (103) | 4. | Metallurgy<br>Mineralogy and Cryst'g'phy | (104) | 3. |
| | | | Mine Engineering<br>Mine Trip. | (110) | 1. |
| Military Drill | | 1. | Military Drill | | 1. |

### THIRD YEAR

| First Semester | | | Second Semester | | |
|---|---|---|---|---|---|
| Mechanics<br>Statics and Str. of Mater'ls. | (101) | 5. | Mechanics<br>Kinetics and Hydraulics. | (102) | 5. |
| Metallurgy<br>Gen. Metallurgy. | (109) | 4. | Metallurgy<br>Gen. Metallurgy. | (110) | 4. |
| Metallurgy<br>Fire Assaying | (105) | 3. | Metallurgy<br>Calorimetry, Mine Gas Anal. | (112) | 2. |
| Metallurgy<br>Laboratory | (107) | 4. | Metallurgy<br>Determinative Mineralogy. | (108) | 3. |
| Geology<br>Gen. Geology. | (165) | 3. | Geology<br>Petrography. | (166) | 2. |
| | | | Civil Engineering<br>Trusses. | (124) | 3. |

### FOURTH YEAR

| First Semester | | | Second Semester | | |
|---|---|---|---|---|---|
| Mine Engineering<br>Gen. Mining. | (105) | 5. | Mine Engineering<br>Gen. Mining. | (106) | 5 |
| Metallurgy<br>Metallurgical Const. | (111) | 2. | Mine Engineering<br>Plans and Specifications. | (104) | 4. |
| Metallurgy<br>Ore Dressing. | (113) | 2. | Metallurgy<br>Metallography, etc. | (114) | 3. |
| Electrical Eng.<br>Elementary Elec. | (103) | 2. | Mechanical Eng.<br>Laboratory. | (192) | 3. |
| Geology<br>Economic Geology. | (167) | 3. | *Mine Engineering<br>Thesis. | (116) | 3. |
| Architecture<br>Photography. | (111) | 2. | *Metallurgy<br>Thesis. | (116) | 3. |

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*Alternative courses. One must be taken

## COMBINATION COURSES

Combination courses, leading to two engineering degrees, can be arranged for any two of the foregoing degrees. The amount of additional time will be at least thirty semester hours in excess of that required for one, and may be more. In no case will the student be required to take all of the work not common to the two courses as published.

For instance a joint course, Mechanical and Electrical Engineering, can be made in five years. Between courses more unlike, such as like Civil Engineering and Mechanical Engineering, six years would be required.

## ARTS-ENGINEERING COURSES

For the benefit of those who desire to possess the advantage of a wider general culture and a broader foundation than can be given in the limits of a four-year professional course, a combination of three years in the College of Arts, Philosophy and Science and three years in the College of Engineering can be so adjusted as to enable the student to secure both the Bachelor of Arts and Bachelor of the appropriate engineering course. The College of Engineering desires to establish similar relations with other educational institutions of approved standing in Ohio and elsewhere by which students can win two degrees in five or six years.

## GRADUATE WORK

The Graduate School has administrative control of the whole subject of graduate work in all of the colleges of the University. The conditions under which advanced degrees can be obtained by graduates of the College of Engineering are as follows:

**Master's Degree.** The degree which will usually be conferred upon candidates whose major work lies in the College of Engineering will be that of Master of Science, (M. Sc.). The course of study will consist of one major and either one or two minors, at least one of the minors being in a different department from that in which the major is taken. A residence of one year devoted wholly to graduate work is required, but graduates of this University may do not to exceed one-half of the required work at another institution offering equivalent opportunities for study. Except in certain special cases, a satisfactory thesis is required.

**Professional Engineering Degrees.** Upon nomination by the Faculty of the College of Engineering, the appropriate professional engineering degree of Civil Engineer, Mechanical Engineer, Electrical Engineer, Engineer of Mines, Ceramic Engineer, Chemical Engineer, or Master of Architecture, may be granted to graduates of this University upon any one of the following plans:

First. Four years of acceptable professional experience and an approved thesis.

Second. A Master of Science degree from this University with a major in engineering, followed by two years of acceptable professional experience and an approved thesis.

Third. One year of acceptable professional experience, followed by one year of approved study at this University, with an appropriate engineering major, and the submitting of an approved thesis.

## COURSES NOT LEADING TO DEGREE

The following short courses, of two years each, are offered by the College of Engineering to meet the needs of that class of young men who have for some reason failed to qualify themselves to enter the regular four-year courses, but whose experience in engineering work has shown them the need of some technical education as a requisite to further progress. These courses are in no sense a substitute for the regular four-year courses, nor are they designed as preparation for subsequent entrance into the regular courses. They aim to give an introduction to the fundamentals of engineering only, and in the shortest time consistent with any real educational result.

Applicants for admission to these courses are required to have at least two years of consecutive practical experience in some branch of the industries related to the one they wish to pursue, and to present a satisfactory certificate to that effect. (See page 16).

## SHORT COURSE IN CLAYWORKING

### FIRST YEAR

| FIRST SEMESTER | | SECOND SEMESTER | |
|---|---|---|---|
| Mathematics (101) | 5. | Mathematics (102) | 5. |
| Elementary Algebra. | | Elementary Algebra. | |
| Mathematics (113) | 5. | Mathematics (114) | 5. |
| Plane and Solid Geom. | | Solid Geom. and Trig. | |
| Chemistry (101) | 4. | Chemistry (102) | 4. |
| Elementary Chemistry. | | Elementary Chemistry and Qualitative Analysis. | |
| Engineering Drawing (113) | 4. | Engineering Drawing (114) | 3. |
| Freehand and Lettering. | | Mechanical Drawing. | |
| Military Drill. | 1. | Military Drill. | 1. |
| Gymnasium. | 1. | Gymnasium. | 1. |

*SUMMER SESSION—Students are required to take two of the following subjects: Shopwork (107), (109) and (115), during the Summer Session at the close of the first year.

### SECOND YEAR

| | | | |
|---|---|---|---|
| Ceramic Engineering (101) | 5. | Ceramic Engineering (104) | 5. |
| Ceramic Chemistry. | | Clay Manufacture. | |
| Ceramic Engineering (103) | 5. | Ceramic Engineering (110) | 2. |
| Clay Manufacture. | | Glazes and colors. | |
| Ceramic Engineering (115) | 2. | Ceramic Engineering (126) | 5. |
| Laboratory. | | Laboratory. | |
| Physics (101) | 6. | Ceramic Engineering (106) | 2. |
| Elementary Physics. | | Ceramic Calculations. | |
| | | Ceramic Engineering (120) | 1. |
| | | Lab. in Calculations. | |
| | | Ceramic Engineering (122) | 2. |
| | | Dryer and Kiln Design. | |
| Military Drill. | 1. | Military Drill. | 1. |

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*Upon presentation of reasons satisfactory to the head of the department students may substitute work in a ceramic factory for the above shopwork courses.

## SHORT COURSE IN INDUSTRIAL ARTS

### FIRST YEAR

| First Semester | | | Second Semester | | |
|---|---|---|---|---|---|
| Mathematics<br>Elementary Algebra. | (101) | 5. | Mathematics<br>Elementary Algebra. | (102) | 5. |
| Mathematics<br>Plane and Solid Geom. | (113) | 5. | Mathematics<br>Solid Geom. and Trig. | (114) | 5. |
| Engineering Drawing<br>Freehand and Lettering. | (113) | 4. | Engineering Drawing<br>Mechanical Drawing. | (114) | 3. |
| Shopwork<br>Pattern Making. | (109) | 2. | Shopwork<br>Adv. Pattern Making. | (112) | 1. |
| Shopwork<br>Forging. | (115) | 2. | Shopwork<br>Foundry. | (106) | 2. |
| | | | Shopwork<br>Chipping and Filing. | (108) | 2. |
| Military Drill. | | 1. | Military Drill. | | 1. |
| Gymnasium. | | 1. | Gymnasium. | | 1. |

### SECOND YEAR

| | | | | | |
|---|---|---|---|---|---|
| Engineering Drawing<br>Descriptive Geometry. | (103) | 3. | Engineering Drawing<br>Machine Sketching. | (104) | 3. |
| Industrial Arts<br>Machines. | (101) | 3. | Industrial Arts<br>Machines. | (102) | 3. |
| Industrial Arts<br>Designing. | (103) | 2. | Industrial Arts<br>Designing. | (104) | 2. |
| Physics<br>Elementary Physics. | (101) | 6. | Industrial Arts<br>Strength of Materials. | (110) | 6. |
| Shopwork<br>Machine Work. | (119) | 3. | Shopwork.<br>Adv. Machine Work. | (122) | 3. |
| Military Drill. | | 1. | Military Drill. | | 1. |

## SHORT COURSE IN MINING

### FIRST YEAR

| | | | | | |
|---|---|---|---|---|---|
| Mathematics | (101) | 5. | Mathematics | (102) | 5. |
| Elementary Algebra. | | | Elementary Algebra. | | |
| Mathematics | (113) | 5. | Mathematics | (114) | 5. |
| Plane and Solid Geom. | | | Solid Geom. and Trig. | | |
| Physics | (101) | 6. | Shopwork | (116) | 2. |
| Elementary Physics. | | | Forging. | | |
| | | | Geology | (162) | 4. |
| | | | Elementary Physiography. | | |
| Military Drill. | | 1. | Military Drill. | | 1. |
| Gymnasium. | | 1. | Gymnasium. | | 1. |

### SECOND YEAR

| | | | | | |
|---|---|---|---|---|---|
| Engineering Drawing | (113) | 4. | Engineering Drawing | (114) | 3. |
| Freehand and Lettering. | | | Mechanical Drawing. | | |
| Chemistry | (101) | 4. | Geology | (164) | 3. |
| Elementary Chemistry. | | | Elementary Geology. | | |
| Mine Engineering | (107) | 2. | Metallurgy | (102) | 4. |
| Mine Plans. | | | Water Supply and Mine Gases. | | |
| Mine Engineering | (101) | 5. | Mine Engineering | (102) | 5. |
| Mine Surveying. | | | General Mining. | | |
| Military Drill. | | 1. | Military Drill. | | 1. |

## SHORT COURSE IN HIGHWAY ENGINEERING

The following course of lectures was given, February 24th to March 8th, 1913, inclusive, at the request of the Ohio Good Roads Federation and at its expense. It was designed to give to County Engineers, Surveyors, and Commissioners, Township Trustees, Road Supervisors, Contractors, Dealers in Road materials, in fact, all persons interested in the existence of, construction of, or maintenance of good roads, an opportunity to get some connected and systematic knowledge of the present status of Highway Engineering. It was not designed to create Highway Engineers, but to try to bring home to the people the necessity of using trained and educated Highway Engineers, if the best results are to be obtained from the expenditures being made for highways.

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### THE COURSE

| | |
|---|---|
| Monday, Feb. 24th | Need of Good Roads.<br>Alignment and Grades of Country Roads.<br>Earth Roads. |
| Tuesday, Feb. 25th | Drainage of Roads.<br>Road Materials, Gravel and Broken Stone.<br>Culvert Materials.<br>Gravel and Macadam Roads.<br>Binders and Fillers for Gravel, Macadam and Brick-paved Roads. |
| Wednesday, Feb. 26th | Preparation of Sub-grades.<br>Culverts.<br>Bridges.<br>Foundation of Roads. |
| Thursday, Feb. 27th | Road Materials—Cement and Sand.<br>Road Materials—Materials and Methods Adapted to Base and Wearing Surfaces of Concrete Roads.<br>Cement and Concrete—Laboratory Demonstration and Field Tests. |

| | |
|---|---|
| Friday, Feb. 28th | Brick Pavements. |
| | Brick Floors and Material for the Same. |
| | Masonry Construction. |
| Saturday, March 1st. | Inspection Trips. |
| Monday, March 3rd. | Road Legislation. |
| | Dust Layers and Oil Treatments. |
| | Water and Bituminous Bound Macadam Roads. |
| | Asphalt and Bituminous Surfaces and Binders. |
| | Maintenance of Bituminous Pavements. |
| | Highways of Europe. |
| Tuesday, March 4th, | Bitumens. |
| | Maintenance and Repairs of Gravel and Macadam Roads. |
| | Paving Brick. |
| | Bitumens (continued). |
| Wednesday, March 5th | Road and Laboratory Demonstrations. |
| | Bituminous Surfaces on Old Pavements and Concrete Bases. |
| | Building Stones of Ohio with Reference to Road Building. |
| Thursday, March 6th | Road Economics. |
| | Plain Concrete Roads. |
| | Brick Pavements and their Maintenance. |
| Friday, March 7th | Symposium of Patent and Proprietary Road Materials and Processes. |
| Saturday, March 8th | Inspection trips. |

This course of lectures was given under the general charge of the department of Civil Engineering. In addition to the instructors of that department and allied departments, the following special lecturers, not regularly connected with the University, were secured.

Wm. P. Blair, Secretary National Paving Brick Manufacturers' Association, Cleveland, Ohio

Arthur H. Blanchard, Professor of Highway Engineering, Columbia University, New York City

John R. Chamberlin, Deputy Highway Commissioner, in charge of Bridges, Ohio State Highway Department

George E. Dingman, County Engineer, Wayne County, Michigan

Albert H. Hinkle, Deputy Highway Commissioner, in charge of Maintenance, Ohio State Highway Department

Arthur N. Johnson, State Highway Engineer of Illinois, Springfield, Illinois

Frank R. Lander, County Engineer of Cuyahoga County, Cleveland, Ohio

James R. Marker, Highway Commissioner, Ohio State Highway Department

Abel S. Rea, Testing Engineer, Ohio State Highway Department

Jesse Taylor, President of Ohio Good Roads Federation, Jamestown, Ohio

Sanford E. Thompson, Consulting Engineer, Newton Highlands, Massachusetts

James T. Voshell, U. S. Highway Engineer, Office of Public Roads, Washington, D. C.

It is the expectation that a similar course will be offered in 1914, but definite announcement cannot be made at this time.

# GROUNDS AND BUILDINGS

The grounds of the University are located about two miles north of the Union Station and extend west from High Street for nearly a mile. They may be reached by the car lines on either High Street or Neil Avenue. The campus proper lies along High Street and contains about one hundred acres. To the west of this lies the University farm which, combined with the campus, has an area of 439 acres. As seen from the map (page 2) the twenty-nine larger buildings, valued at over one and a quarter million dollars, are irregularly arranged near the center of the campus, leaving a roughly oval space in the center. Three of the buildings, Brown Hall, Lord Hall, and the Robinson Laboratory are used exclusively for the work of the college of Engineering and are located near each other and near the power plant in the northwestern portion of the grounds, Besides these, the three other buildings described below are largely used by the students of this college, aud others to a less degree.

A bulletin containing views of the buildings and laboratories in which engineering instruction is given may be obtained by addressing the University Editor.

## BROWN HALL

Of the three buildings which are entirely occupied with the work of the College, the oldest is Brown Hall, a handsome brick structure named after the second Dean of the College of Engineering. This building was completed in 1904 at a cost of $75,000. The main part of this building is 217 by 50 feet, and these are two short wings extending to the rear. It accommodates the departments of Architecture, Civil Engineering, and Engineering Drawing.

## LORD HALL

This building was named after the first Dean of the College of Engineering and Director of the School of Mines, Nathaniel Wright Lord. It was completed in 1906, and cost $85,000. It is 270 feet long by 70 feet wide with two one-story fireproof wings for the accommodation of furnace work. This building accommodates the departments of Ceramic Engineering, Metallurgy, Mechanics and Mine Engineering. The basement, which is wholly above grade, is used for laboratories and there are also a number of laboratories on the first and second floors. These floors also accommodate the lecture rooms, drawing rooms, and offices.

## THE ROBINSON LABORATORY

This is a building of modern shop construction with sawtooth roof, made up of one forty-eight-foot and seven thirty-foot divisions. These, together with enclosed galleries at the sides, make a total length of 310 feet, with a depth of 112 feet. The enclosed galleries and the space under them are used for special laboratories, museums, classrooms, and offices. The central sections are lighted by the skylights with northern exposure, and are occupied by the different laboratories of the Mechanical and Electrical Engineering departments, and by an amphitheatre suitable for demonstration work, which is used by both departments. This building, which was completed, in 1908, cost $75,000, exclusive of equipment, and is one of the most practical laboratory buildings in the country. It is named in honor of Dr. Stillman W. Robinson, first professor of Mechanical Engineering in this University.

## HAYES HALL

This building was named in honor of President Rutherford B. Hayes, at one time a trustee of the University. It is at present occupied by the departments of Industrial Arts and Home Economics. This building, which was completed in 1893, is irregular in shape, with frontage of 166 feet and greatest depth of 144 feet. The central section of the building is occupied by the machine and carpenter shops, foundry, forge room, offices, and drawing rooms.

## CHEMISTRY HALL

In this building is given all the instruction in pure chemistry, and also the technical courses in chemical engineering. The building was completed in 1907, at a cost of $100,000. It has a frontage of 200 feet and a depth of 70 feet, with laboratories, lecture rooms, offices, etc., occupying two stories and a high basement. It has one of the finest equipments in the University. (See also Chemical Engineering).

## PHYSICS HALL

This building is devoted to the work of the Physics Department. It is 105 feet long by 102 feet in its greatest depth, with three stories and a high basement. It was erected in 1906 at a cost of $80,000, and is equipped with forty thousand dollars worth of modern apparatus. A large part of the basement is given to the laboratory work in electrical measurement.

## OBSERVATORY

The Emerson McMillin Observatory is the gift of Emerson McMillin of New York City. It is located in the southern part of the grounds, and is provided with excellent equipment for purely scientific research, or for the teaching of astronomy in its engineering aspects.

## ORTON HALL

This building was erected in 1891 for the Department of Geology and represents in itself the building stones of Ohio, most of the characteristic varieties of which were used in its construction. For the ment, see Geological Department.

## LIBRARY

A new Library building, costing with its equipment, exclusive of books, $300,000. has been recently completed and is in use. The Library consists of approximately 125,000 bound volumes and 12,000 unbound publications. The main part of the books are kept in the Library, but there are important branch libraries in Chemistry in the Chemistry Hall; in Mining, Metallurgy and Ceramic Engineering in Lord Hall; in Electrical Engineering and Mechanical Engineering in the Robinson Laboratory, and some smaller ones in other depart-equipments.

## UNIVERSITY HALL

In this building, which is the oldest on the grounds, the greater part of the work in mathematics and language is given. This building also contains the office of the President, the Secretary of the Board of Trustees, and the Registrar.

## GYMNASIUM AND ARMORY

The Gymnasium and Armory is a beautiful building erected in 1898 at the cost of $115,000. Its main floor is 80 by 150 feet clear, and there is a gallery twelve feet above the floor, containing a running track, and seats for about seven hundred persons. The basement contains another gymnasium room 80 x 40 feet, also used by the Military Department a portion of the time for a target range. The men's locker room contains 640 lockers and the women's, 115. The building is well equipped with gymnastic apparatus, shower baths, and swimming pools for men and for women. The headquarters, officers' quarters, band room, and gun racks of the Military Department are located in this building.

## POWER HOUSE

The University provides the light, heat and power for all of its buildings from a central station. There is a boiler house 38 by 100 feet, with four 150, one 450, and one 500 horse-power watertube boilers, equipped with turbine, steam-driven feed pumps, automatic stokers, and coal and ash-handling apparatus. Fuel is brought to the University over a spur from the Hocking Valley Railway, about three-quarters of a mile long. The cars are unloaded by a locomotive crane, with clam-shell unloader. The coal is dropped by this apparatus into the chutes of the coal-handling system, which carries it to the boilers, or is dumped into concrete coal-storage bins, 40 by a 100 feet in area. Near the boiler house is the engine house, 40 by 60 feet, with an L, 30 by 40 feet, equipped with the following: Two 125 kilowatt two-phase direct-connected steam units, one 100 kilowatt gas engine unit, one 300 kilowatt turbo-generator set, one 15 kilowatt exciter set, and two small air compressors; the hot water heating apparatus located in the L utilizes exhaust steam for heating eight buildings, and consists of the following: One large exhaust heater, one live steam heater, one turbine pump, and one surface condenser. The power and boiler houses are connected through a large tunnel with nearly all the buildings of the University, and through this tunnel run the pipes for steam, water, and gas, as well as the electrical distribution for light and power. The power plant is a strictly modern and efficient equipment, and is of value as an object lesson to all students of engineering.

# THE DEPARTMENTS OF INSTRUCTION

## ARCHITECTURE

Office, Room 22, Brown Hall
PROFESSOR BRADFORD, ASSOCIATE PROFESSOR CHUBB, MR. HASKETT
MR. FIELD.

### EQUIPMENT

The department occupies the west end of Brown Hall, where it is provided with large, well lighted designing rooms, a lecture room with projection lantern, library, and office.

In the designing rooms, each student is provided with a drawing table and locker for his exclusive use. The equipment includes a fine collection of plaster casts of architectural orders, carved ornament and statuary, including a set by Caproni from the noted monuments of ancient and mediæval architecture, two thousand lantern slides of the masterpieces of architecture, a collection of large photographs, a collection of portfolios of noted architectural plates, drawings and specifications of erected structures, samples of building materials, fixtures, etc. The department library has a good collection of standard works and bound volumes of the standard periodicals.

The courses in photography are given in this department. The laboratory for this work is one of the best in the country and includes a dark room which will accommodate forty students working at the same time, each with a complete and separate stall. There is a printing and toning room, and also a room for indoor and special work. Equipment of note consists of fourteen high-grade view cameras fitted with fine lenses, also shutters, color screens and exposure meters, a Bausch and Lomb photo-micrographic apparatus of the finest quality, special photographic arc lamps, and three copying cameras. There is an enlarging room equipped for handling any work up to the largest practical sizes, and also a separate blue printing room equipped with a modern cylindrical arc lamp, blue printing machine, also washing tanks, drying racks, etc.

### SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**101. History of Architecture.** Three credit hours. Architecture, second year, first semester. Mr. Bradford.

Lectures, illustrated by lantern slides.

**102.** Continuation of 101. Architecture, second year, second semester. Mr. Bradford.

**103. Order Problems.** Two credit hours. Architecture, second year, first semester. Prerequisite, Engineering Drawing 102, Concurrent with Engineering Drawing 107. Mr. Chubb. Mr. Field.

Drawing details of the Orders.

**104. Order Problems.** Five credit hours. Architecture, second year, second semester. Prerequisite, Architecture 103. Mr. Chubb. Mr. Field.

**107. Design.** Five credit hours. Lectures and practise. Architecture, third year, first semester. Prerequisite, Architecture 104, and concurrent with Architecture 113. Mr. Chubb. Mr. Field.

**108. Design.** Four credit hours. Architecture, third year second semester. Prerequisite. Architecture 107. Mr. Chubb.

**109. Decoration and Ornament.** Three credit hours. Architecture, third year, first semester. Prerequisite, Architecture 104 and Engineering Drawing 115. Mr. Chubb.

**110. Working Drawings.** Four credit hours. Architecture, third year, second semester. Prerequisite, Architecture, 107. Mr. Chubb.

**111. Photography.** Two credit hours. Civil Engineering, third year, first semester; Mine Engineering, fourth year, first semester. Prerequisite, Chemistry 105, 106, or 109, 110. Mr. Haskett.

**112. Photography.** Two credit hours. Mechanical Engineering and Architecture, third year, second semester. Prerequisite. Chemistry 105, 106, or 109, 110. Mr. Haskett.

**113. Principles of Architectural Composition.** Two credit hours, Architecture, third year, first semester. Concurrent, Architecture 109. Mr. Chubb.

**114. Designing.** Three credit hours. Architecture, fourth year, second semester. Prerequisite, Architecture 108. Mr. Bradford. Mr. Chubb.

**115. Designing.** Six credit hours. Architecture, fourth year, first semester. Prerequisite, Architecture 108. Mr. Bradford. Mr. Chubb.

**116. Professional Practise.** Four credit hours, Architecture, fourth year, second semester. Prerequisite. Architecture. 115. Mr. Bradford.

**117. Sanitary Plumbing.** One credit hour. Architecture, fourth year, first semester. Mr. Bradford.

**118. Thesis.** Five credit hours. Architecture, fourth year, second semester. Mr. Bradford. Mr. Chubb.

**119. Masonry.** Two credit hours. Architecture, fourth year first semester. Prerequisite, Architecture 110. Mr. Bradford.

**120. Summer Work.** Four credit hours. The equivalent of four weeks of work in an architect's office, or a problem in design, assigned by the department. Between the second and third years.

**121. Summer Work.** Four credit hours. The equivalent of four weeks of work in an architect's office or a problem in design, assigned by the department. Between the third and fourth years.

**122. Photography.** Two credit hours. Second semester. Prerequisite, Architecture 111 or 112. Mr. Haskett.

**124. Shades, Shadows and Perspective.** Three credit hours. Architecture, second year, second semester. Prerequisite, Engineering Drawing 107. Mr. Chubb. Mr. Field.

## FOR GRADUATES ONLY

For a complete description of the graduate work, the bulletin of the Graduate School should be consulted.

**201-202. Advanced Design.** Three to ten credit hours. The year. Library, conference, and drawing room work. Time to be arranged with the instructor. Prerequisite, the permission of the instructor. This course deals with special and complex problems in architectural design, and is under the supervision of Mr. Bradford and Mr. Chubb.

**203-204. Research Work.** Three credit hours. The year.

Library and conference work. Time to be arranged with the instructor. Prerequisite, the permission of the instructor. This course deals with problems of Architectural History, and is under the supervision of Mr. Bradford.

# ASTRONOMY

Office, Emerson McMillin Observatory

PROFESSOR LORD, ASSOCIATE PROFESSOR MANSON

## EQUIPMENT

The equipment consists of six sextants, two small theodolites, five chronometers, a Riefler standard clock and 2½-inch zenith telescope, by Troughton & Simms. For accurate time or longitude there is provided a 3-inch combined portable transit and zenith telescope, by Saegmuller, and chronograph by Warner & Swasey. For refined azimuth determination there is a theodolite by Troughton & Simms, equipped with 12-inch horizontal and vertical circles, reading to single seconds of arc.

Further equipment comprises a 12½-inch equatorial telescope with mounting by Warner & Swasey, objective by Brashear, and a Universal star spectroscope by Brashear; a position micrometer by Warner & Swasey; a 4-inch portable equatorial by Alvan Clark; comparator by Zeiss, and a set of meteorological instruments. There is also provided a fully equipped instrument shop.

Ten students can work each clear night under constant supervision of the instructor, the inconvenience of open air observations being reduced to a minimum.

## SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**104. Astronomy, Geodesy and Least Squares.** Three credit hours. Civil Engineering,third year, second semester. Prerequisite, the Calculus. Mr. Lord, Mr. Manson.

**105.** Continuation of 104. Three credit hours. Civil Engineering, fourth year, first semester. Mr. Lord, Mr. Manson.

**Note**—For graduate courses, the bulletin of the Graduate School should be consulted.

# CERAMIC ENGINEERING

Office, Room 131, Lord Hall

PROFESSORS ORTON, PENCE AND STALEY, MR. HARROP,
MR. LYSATT.

## EQUIPMENT

The Department of Ceramic Engineering occupies the western third of Lord Hall. In the basement are a pottery laboratory, a brick machine room, and a room chiefly devoted to the grinding of dry materials. There is also a large store room, and in an attached fireproof wing a kiln room. On the second floor, besides offices and class-rooms, there is a chemical laboratory and a museum of ceramic products. On the second floor are rooms for physical testing and measurement, advanced thesis work, and drawing.

The facilities of the department comprise a chemical laboratory equipped for forty students and especially suited for mineral analysis; a mechanical outfit for the preparation of clays for pottery manufacture, and the production of the ware itself; machinery for grinding and tempering clays; a plant for the manufacture of brick, tiles, pipes, and hollow goods; a kiln house eqipped with three downdraft kilns, using solid fuel, and two Caulkins muffle kilns arranged to fire with either oil or gas, and several small furnaces for burning cements, testing refractory materials, melting glass, and making fritts, using compressed air and natural gas; an electric furnace for high temperature work. The lecture room is equipped with a series of wall charts, cases containing a mineral collection and a large number of American and foreign clays, a collection of upwards of five hundred lantern slides illustrating the occurrence, preparation, and manufacture of clays. A ceramic museum containing a small collection of pottery and clay products has been assembled, mostly by donation. A library of the best literature on ceramic technology, containing about four hundred volumes, is open to the students daily from 8 A. M. to 10 P. M.

## SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**101. Ceramic Chemistry**. Five credit hours. Ceramic Engineering and Short Clay-working, second year, first semester. Prerequisite, Chemistry 106 or 110. Mr. Staley.

Quantitative analysis of limestone and simple minerals.

**102. Ceramic Chemistry.** Three credit hours. Ceramic Engineering, second year, second semester. Prerequisite, Ceramic Engineering 101 Quantitative analysis of clays, fire gases, etc. Mr. Staley.

**103. Ceramic Manufacture.** Five credit hours. Ceramic Engineering, third year, first semester; Short Clay-working, second year, first semester. Origin, occurrence, constitution, properties and methods of winning ceramic material. Mr. Orton.

**104. Continuation of 103.** Five credit hours. Ceramic Engineering, third year; Short Clay-working, second year, second semester. General principles of manufacture of clay wares; theory and practise of drying and burning. Mr. Orton.

**106. Ceramic Calculations.** Two credit hours. Ceramic Engineering and Short Clay-working, second year, second semester Prerequisite, Ceramics 101. Mr. Pence.

Calculations involved in blending of ingredients used in ceramic mixtures; determinations of limits of variation in given series; limits of errors; volume calculations; problems in heat

**108. Physical and Chemical Measurements of Clays.** Three credit hours. Ceramic Engineering, third year, second semester.

Application of physical chemical laws to fusions of mineral mixtures; determination of melting points; deformation periods; relative viscosity of fused magmas; study of influence of salts on viscosity of slips, etc. Mr. Staley.

**110. Colors and Glazes.** Two credit hours. Ceramic Engineering, third year, second semester; Short Clay-working, second year, second semester. Prerequisite, Ceramics 101 and 103.

The decoration of clay wares by glazing and coloring. This course deals with decoration from the technological side only, not touching upon the artistic. Mr. Pence.

**111. Laboratory Work in Ceramics.** Five credit hours. Ceramic Engineering, fourth year, first semester. Prerequisite, Ceramic 104, 108, 110.

Practise in clay testing and measurement of physical properties of clays; the production of bodies made from single clays and of clays with minerals. In each case the bodies are burned and tested. Mr. Pence.

**112. Continuation of 111.** Five credit hours. Ceramic Engineering, fourth year, second semester. Prerequisite, Ceramics 111.

The production of slips, engobes, and glazes, and the study of the methods of coloring. Mr. Pence.

**113. Ceramic Designing.** Two credit hours. Ceramic Engineering, fourth year, first semester. Prerequisite, Ceramics 104.

Designing, estimating cost of, and writing specifications for kilns and dryers. Mr. Harrop.

**114. Continuation of 113.** Three credit hours. Ceramic Engineering, fourth year, second semester. Prerequisite, Ceramics 113.

The work started in Ceramics 113 is extended to the design and equipment of clay-working plants. Mr. Harrop.

**115. Laboratory Work in Ceramics.** Two credit hours. Short Clay-working, second year, first semester. Concurrent, Ceramics 103.

Testing of clays and minerals employed in clay manufacture and in blending of same for ceramic purposes. Mr. Pence.

**116. Thesis.** Four credit hours. Ceramic Engineering, fourth year, second semester.

**118. Cement Manufacture.** Five credit hours. Alternative with Ceramics 112, Ceramic Engineering, fourth year, second semester. Prerequisites, 102 and 104.

The theory of hydraulicity, the compounding, manufacture, and testing of natural and Portland cements and other hydraulics. Mr. Staley.

**120. Laboratory Drill in Ceramic Calculations.** One credit hour. Short Clay-working, second year, second semester.

This course is supplementary to Ceramics 106 for Short Course students. Mr. Pence.

**122. Dryer and Kiln Design.** Two credit hours. Short Clay-working, second year, second semester. Concurrent with Ceramics 106.

A graphic study of dryer and kiln design. Mr. Harrop.

**126. Laboratory Work in Ceramics.** Five credit hours. Short Clay-working, second year, second semester. Prerequisite, Ceramics 115.

The preparation of slips, engobes and glazes, and the study of the methods of coloring. Mr. Pence.

## FOR GRADUATES ONLY

For a complete description of the graduate work, the bulletin of the Graduate School should be consulted.

**201-202. Research Work.** Three to ten credit hours. The year. Library, conference and laboratory work. Time arranged with the Instructor. Prerequisite, the permission of the instructor in charge.

Research work in analytical and physical chemistry of silicates is conducted under the supervision of Mr. Staley; in mineralogy and geology of clay deposits and testing of clays and clay products, under Mr. Orton; in the production and constitutions of ceramic bodies, under Mr. Pence; in the engineering and designing of structures for ceramic industries, under Mr. Harrop.

# CHEMISTRY

Office, 100 Chemistry Hall

PROFESSOR MCPHERSON, EMERITUS PROFESSOR NORTON, PROFESSORS HENDERSON, FOULK, EVANS, AND WITHROW, ASSISTANT PROFESSOR WILKINSON, DR. BOORD AND DEPARTMENT ASSISTANTS

## EQUIPMENT

The Department of Chemistry occupies the greater part of Chemistry Hall. In the basement are two laboratories, each accommodating 500 students in elementary chemistry. There are also laboratories for industrial chemistry, for organic combustion work and a repair shop. On the first floor are the main office of the department, a large laboratory for organic chemistry accommodating eighty students, a smaller one for research work, a lecture room, a library and a main store room where all the laboratory and office supplies of the University are kept in stock.

On the second floor is the main lecture room, having a seating capacity of 300, and equipped with lantern, specimens, etc., for demonstration work. On this floor are laboratories for the following lines of work: Physical chemistry, general analytical work, advanced inorganic chemistry, and the chemical investigation of water. There are also three small private laboratories, the balance room, a small lecture room, and the electrical room, containing the storage batteries, a mercury rectifier and switchboard. On the upper floor are three recitation rooms. The apparatus for ventilating the hoods and the large still for furnishing distilled water are also located here.

The department is well equipped with all the necessary apparatus for carrying on not only the elementary work in chemistry, but advanced and research work as well. The general chemical apparatus is loaned to the student, and no charge is made if it is returned in good order. The laboratories are supplied with all the modern conveniences, and each student has his own locker in which he keeps his apparatus. The storage battery room is connected with the various laboratories so that the current can be utilized wherever needed.

## SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**101. Elementary Chemistry.** Four credit hours. First semester, one lecture, one quiz, six hours laboratory weekly. Short Mining, second year. Short Clay-working, first year.

A general introductory course on the chemistry of the non-metals. It is distinctly elementary in character and is arranged for students in short courses only. No credit is allowed for it in the regular four year courses. Students taking this course should follow with course 102, second semester. Mr. Evans, Mr. Hockett, Mr. Hummel.

**102. Elementary Chemistry and Qualitative Analysis.** Continuation of Chemistry 101. Short courses. Second semester.

A general introductory course on the chemistry of the metals. The laboratory work deals with the elementary principles of qualitative analysis. The course is arranged for students in short courses only No credit is allowed for it in the regular four year courses. Mr. Evans. Mr. Hockett.

**105. Elementary Chemistry**. Four credit hours. First semester, One lecture, one quiz, and six hours laboratory weekly. Taken by first year students in all four year courses who have not presented chemistry as an entrance credit. A general course in the chemistry of non-metals. Mr. Evans, Mr. Day, Mr. Caldwell.

**106. Elementary Chemistry and Qualitative Analysis.** A continuation of Chemistry 105. Four credit hours. Second semester.

A general course in the Chemistry of the metals. The laboratory work is a general introductory course in qualitative analysis. Mr. Evans, Mr. Caldwell, Mr. Day.

**109. General Chemistry.** Four credit hours. First semester. One lecture, one quiz, and six hours laboratory weekly. Taken by first year students in all four year courses who have presented Chemistry as an entrance credit. A general course on the chemistry of non-metals. Mr. Evans, Mr. Holler, Mr. Thurston.

**110. General Chemistry and Qualitative Analysis.** A continuation of Chemistry 109. Four credit hours. Second semester.

A general course in the chemistry of the metals. It is more advanced than Chemistry 106. The laboratory work is a general course in qualitative analysis. Mr. Evans, Mr. Holler, Mr. Thurston.

**113. Advanced General Chemistry.** Two credit hours. Two lectures weekly. Chemical Engineering, second year, first semester. Prerequisite, Chemistry 106 or 110.

A course on the fundamental topics of General Chemistry designed as a thorough review and extension of the first year course. Mr. Henderson.

**114. Advanced General Chemistry.** A continuation of Chemistry 113. Two credit hours. Chemical Engineering, second year, second semester. Mr. Henderson.

**117. Qualitative Analysis.** Three credit hours. First semester. One lecture and six hours laboratory weekly. Time to be arranged. Prerequisite, an acceptable course in general chemistry. Mr. Wilkinson.

**119. Quantitative Analysis.** (a) Three credit hours. One lecture and six hours laboratory weekly. Mine Engineering, second year, first semester. (b) Four credit hours. One lecture and nine hours laboratory weekly. Chemical Engineering, second year, first semester. Prerequisite, Chemistry 106 or 110. It is desirable that this course be accompanied by course 119. Mr. Foulk, Mr. Wilkinson.

The elementary principles of gravimetric and volumetric analysis.

**120. Quantitative Analysis.** Four credit hours. One lecture and nine hours laboratory weekly. Chemical Engineering, second year, second semester. Prerequisite, Chemistry 119. A continuation of Chemistry 119 with typical analytical methods in gravimetric and volumetric analysis. This course must be accompanied by Chemistry 124. It is desirable that it be accompanied by Chemistry 114. Mr. Foulk, Wilkinson.

**124. Chemical Problems.** One credit hour. Chemical Engineering, second year, second semester. Mr. Foulk.

Extended practise in the solution of problems pertaining to gravimetric and volumetric analysis. This course is arranged to accompany Chemistry 120.

**136. The Reading of Chemical Literature.** Two credit hours. Chemical Engineering, elective, third year, second semester. Prerequisite, one year of German. Mr. Foulk.

The object of this course is to afford practise in the rapid reading of German chemical literature, the selections being made with special reference to the technical terms of the science.

**140. Thesis.** Four credit hours. Chemical Engineering, fourth year, second semester.

**151. Organic Chemistry.** Two credit hours. Two lectures weekly. Chemical Engineering, third year, first semester. Prerequisite, Chemistry 114 and 120. Mr. McPherson.

General course in Organic Chemistry.

**152.** Continuation of course 151. Two credit hours. Two lectures weekly. Chemical Engineering, third year, second semester. Prerequisite, Chemistry 151. Mr. McPherson.

**153. Organic Chemistry.** Two or three credit hours. Six or nine hours laboratory weekly. Chemical Engineering, third year first semester. Must be accompanied or preceded by Chemistry 151. Mr. McPherson, Mr. Boord.

A general course in the preparation of typical organic compounds

**154.** Continuation of course 153. Two or three credit hours Six or nine hours laboratory weekly. Chemical Engineering, elective third year, second semester. Must be preceded or accompanied by Chemistry 152. Mr. McPherson, Mr. Boord.

**157. Physical Chemistry**. Three credit hours. Three lectures weekly. Chemical Engineering, fourth year, first semester, and Ceramic Engineering, third year, first semester. Prerequisite, Chemistry 114, 120, and 152. Mr. Henderson.

This is a general course in Physical Chemistry.

**158. Physical Chemistry.** Three credit hours. Three lectures weekly. Chemical Engineering, fourth year, second semester. Ceramic Engineering, third year, second semester. A continuation of Chemistry 157. Mr. Henderson.

**162. Physical Chemistry.** Two or three credit hours. Six or nine hours laboratory weekly. Elective, second semester. A laboratory course designed to illustrate the general lecture course 157-158. Mr. Henderson.

**165. Quantitative Analysis.** Advanced course. Three to five credit hours. First semester. Two lectures, three to nine hours laboratory work weekly. Chemical Engineering, elective, third year. Prerequisite Chemistry 119-120. Mr. Foulk.

A general survey of the methods of quantitative analysis.

**167. Special Methods of Analysis.** Three to five credit hours. First semester. One lecture and six to twelve hours laboratory work weekly. Chemical Engineering, elective, third year. Prerequisite Chemistry 119-120. Mr. Wilkinson.

Selections may be made from gas analysis, microchemical analysis and spectrum analysis. Time to be arranged.

**168. Qualitative Analysis.** Advanced course. Three to five credit hours. One lecture, six to twelve hours laboratory weekly. Chemical Engineering, elective, third year, second semester. Prerequisite, Chemistry 120, or equivalent. Mr. Wilkinson.

Extended work in general qualitative analysis including the more important of the rare elements.

**176. Sanitary Analysis.** Three credit hours. Two lectures and three hours laboratory weekly. Chemical Engineering, elective, third year, second semester. Prerequisite, Chemistry 120, or equivalent. Mr. Foulk.

A study of the methods of sanitary water analysis and interpretation of results.

**177. Industrial Chemistry.** Two credit hours. First semester. Two lectures weekly. Prerequisite, Chemistry 113-114 and 153-154. Mr. Withrow.

A general course in the principles underlying the application of chemistry in the industries.

**178. Industrial Chemistry.** One credit hour. Second semester. One lecture weekly. Prerequisite, Chemistry 177. Mr. Withrow.

**182. Industrial Inspection Trip.** A six day excursion at a suitable time in connection with Course 177-178 for the inspection of industrial chemical processes in actual operation. The entire expense is about $30. A satisfactory report on the work inspected is required. Mr. Withrow.

**184. Written Reports.** A course of assigned reading upon some industrial chemical process and a written report of the same. This is a substitute for Chemistry 182, but the substitution is only allowed upon presentation of reasons satisfactory to the instructor in charge. Mr. Withrow.

**185. Industrial Chemistry**. Two credit hours. One conference, five hours laboratory work weekly. Prerequisite, Chemistry 119-120. Prerequisite or Concurrent, 177. A course in industrial chemical research. Mr. Withrow.

**186. Industrial Chemistry.** Three credit hours. One conference, eight hours laboratory work weekly. Prerequisite, Chemistry 119-120. Prerequisite or Concurrent, Chemistry 177-178. A course of industrial chemical research and technical analysis. Mr. Withrow.

**187. Inorganic Preparations.** Two or three credit hours. Six or nine hours laboratory weekly. Chemical Engineering, elective, third year, first semester. Prerequisite, Chemistry 114. A course in the preparation of a limited number of compounds chosen so as to give practise in the different kinds of manipulation involved in the preparation of inorganic compounds. Mr. Henderson.

**188.** Repetition of Course 187.

**191. Rare Elements.** Two credit hours. Two lectures weekly. Elective, second semester. Given biennially. Not given 1913-14. Prerequisite, Chemistry 114 and 120. Mr. Henderson.

A general course on the chemistry of the rare elements, including a discussion of their increasing economic importance

**194. Applied Electro-Chemistry.** Two credit hours. Two lectures weekly. Elective, second semester. Prerequisite, Chemistry 158, except by the special permission of the instructor. Mr. Withrow.

A descriptive course covering the application of the Electric Current in chemical industries.

### Graduate Work

For full information relative to the graduate work offered by this Department, the bulletin of the Graduate School should be consulted

**201-202. Physical Chemistry.** Three credit hours. The year, or may be elected either semester separately. Nine hours laboratory work weekly. Prerequisite, Chemistry 157-158. Mr. Henderson-

A general course on physico-chemical measurements.

**205-206. Organic Chemistry.** Advanced course, Three to five. credit hours. The year. Library, conference and laboratory work. Prerequisite, Chemistry 153-154. Mr. McPherson.

Special attention is given to the preparation of organic compounds with reference to yield and purity of products. Extended practise is also given in the quantitative determination of the elements present in organic compounds.

**221. The Phase Rule.** Two credit hours. First semester. Two lectures weekly. Given in 1913-14, and biennially thereafter. Prerequisite, permission of the instructor in charge. Mr. Henderson.

A general course on the Phase Rule including the elements of chemical thermodynamics. Mr. Henderson.

**224. Electro Chemistry.** Two credit hours. Second semester. Two lectures weekly. Given in 1913-14. and biennially thereafter. Prerequisite, permission of the instructor in charge. Mr. Henderson.

**227. Analytical Chemistry.** Two credit hours. First semester. Two lectures weekly. Prerequisite, permission of the instructor Mr. Foulk.

**231-232. Chemical Seminar.** One credit hour. The year.

All those engaged in giving instruction in the department, together with the fellows and graduate students, meet for an extended discussion of chemical problems of general interest.

**235-236. Research Work.** Five to ten credit hours. The year Library, conference and laboratory work. Time arranged with instructor. Prerequisite, permission of the instructor in charge. Research work in organic chemistry is conducted under the supervision of Mr. McPherson and Mr. Evans; in physical and general chemistry under Mr. Henderson; in analytical chemistry under Mr. Foulk and Mr. Wilkinson; in industrial and electro-chemistry under Mr. Withrow.

## CIVIL ENGINEERING

Office, Room 33, Brown Hall

PROFESSORS SHERMAN, ENO AND MORRIS, ASSISTANT PROFESSORS SCHLAFLY AND HEWERDINE, MR. HINDMAN, MR. WAID, MR. MCCALL.

### EQUIPMENT

The department occupies the eastern half of Brown Hall. For drafting, three spacious and well-lighted drawing rooms are provided for the work of the second, third, and fourth-year students, respectively. In each room is a collection of working drawings, prints, maps, etc., gathered from practising engineers, and arranged in suitable file cases for ready consultation by the student. A large blue-print room on the ground floor is equipped with electrical blue-print apparatus, in addition to the ordinary sunlight frames.

For field work, the instruments are one theodolite, eighteen transits fitted for various kinds of surveying, thirteen leveling instruments, plane table, solar compass, solar attachments, high-grade aneroid barometers, drainage levels, surveying camera, rods, chains, tapes, handlevels, etc. Two current meters with accessories, and a rating course 175 feet long in the rear of the building furnish facilities for carrying on hydrographic work.

The cement-testing laboratory is fitted with necessary appliances for making the ordinary test. It contains Fairbanks and Riehle tensile testing machines, briquette molds, sieves, apparatus for making hot tests, etc., and a machine for testing plain and reinforced concrete beams.

The department also owns a complete outfit for carrying on in camp the work of summer surveying.

## SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**101. Land Surveying.** Four credit hours. Four recitations weekly. Civil Engineering, second year, first semester. Prerequisite, Mathematics 132, Engineering drawing 102. Mr, Sherman Mr. Eno, Mr. Schlafly, Mr. Hewerdine.

Care and use of instruments, Farm, City, and Hydrographic Surveying.

**101a. Field Practise.** One credit hour. Three hours per week in field. Civil Engineering, second year, first semester. Prerequisite, concurrent Civil Engineering 101. Field exercises in use of instruments and surveying. Mr. Schlafly, Mr. Hewerdine, and Dept. Instructor,

**102. Railroad Surveying.** Three credit hours. Three recitations per week. Civil Engineering, second year, second semester. Prerequisite Civil Engineering 101 and 101a. Simple, compound, and transition curves, frogs, switches, and earthwork. Mr. Sherman, Mr. Schlafly, Mr. Hewerdine.

**102a. Field Practise.** One credit hour. Three hours per week in field. Civil Engineering, second year, second semester. Prerequisite, concurrent Civil Engineering 102. Field practise in laying out curves, frogs, switches, and earthwork. Mr. Schlafly, Mr. Hewerdine, aud Dept. Instructors.

**103. Topographic Drawing** Two credit hours, six hours per week in drafting room. Civil Engineering, second year first semester. Prerequisite, Engineering Drawing 102. Exercises in black ink and color topographic drawing. Mr. Sherman, Mr. Eno.

**104. Summer Surveying Camp.** Four credit hours. Civil Engineering at close of second year. Prerequisite, Civil Engineering 101a, and 102a.

Four weeks of six days per week of ten hours per day, from the middle of June to the middle of July.

**105. Topographic Surveying.** Three credit hours. Nine hours per week in field or drawing room. Civil Engineering, third year, first semester. Prerequisite, Civil engineering 101, 102, and 104. Mr. Schlafly, Mr. Hewerdine.

Field and office work in four or five kinds of topographic surveying.

**106. Roads and Streets.** Three credit hours. Three recitations weekly. Civil Engineering, third year, second semester. Prerequisite, Civil Engineering 102 and 104. Mr. Eno.

**107. Stereotomy.** Three credit hours. Recitations, lectures, and drawing. Civil Engineering, third year, first semester. Prerequisite, Engineering Drawing 106. Mr. Schlafly, Mr. Hindman.

**108. Timber Construction.** Three credit hours. Lectures and drawing. Civil Engineering, third year, second semester. Prerequisite, Engineering Drawing 105, Concurrent Mechanics 102. Mr. Schlafly, Mr. Hewerdine.

**109. Sanitary Engineering.** Two credit hours. Two recitations per week. Civil Engineering, third year, first semester. Prerequisite Civil Engineering 102, and 104. Mr. Eno.

**110. Stresses in Structures.** Four credit hours. Four hour recitations weekly. Civil Engineering, third year, second semester. Concurrent Mechanics 102. Mr. Morris.

**111. Summer Surveying Camp.** Four credit hours. Civil Engineering at close of third year. Prerequisite, Civil Engineering 104, and 105.

Four weeks of six days per week of ten hours per day, from the middle of June to the middle of July.

**112. Railway Location.** Four credit hours. Four recitations per week. Optional with Civil Engineering 114. Civil Engineering, fourth year, second semester. Prerequisite, Civil Engineering 102 and 111, and Mechanics 102. Mr. Sherman.

**113. Bridge Designing**. Four credit hours. Four recitations per week. Civil Engineering, fourth year, first semester. Prerequisite, Civil Engineering 110. Mr. Morris.

**114. Advanced Bridges.** Four credit hours. Four recitations per week. Optional with Civil Engineering 112. Civil Engineering, fourth year, second semester. Prerequisite, Civil Engineering 113. Mr. Morris.

**115. Masonry Construction.** Three credit hours. Three recitations weekly. Civil Engineering, fourth year, second semester. Prerequisite, Civil Engineering 111, Mechanics 102. Mr. Sherman.

**116. Masonry Structures.** Three credit hours. Three recitation, lecture or drawing periods per week. Civil Engineering, fourth year, second semester. Prerequisite, Civil Engineering, 115. Mr. Sherman.

**117. Water Supply.** Three credit hours. Three recitations per week. Civil Engineering, fourth year, first semester. Prerequisite, Civil Engineering 111, Mechanics 102. Mr. Eno.

**117a.** Repetition of course 117, in the second semester. Mr. Eno.

**118. Cement and Concrete.** Three credit hours. Architecture Ceramic, and Civil Engineering, fourth year, second semester. Prerequisite, Mechanics 102, or 104. Mr. Morris. Mr. Heidman.

**118a.** Repetition of course 118 in the first semester. Mr. Morris. Mr. Hindman.

**119. Thesis.** One credit hour. Civil Engineering, fourth year, first semester. Prerequisite, Civil Engineering 110, and 111.

**120. Contracts and Specifications.** Two credit hours. Two recitations or lectures weekly. Civil Engineering, fourth year, second semester. Prerequisite, Civil Engineering 106, 109, and 115. Mr. Adams and Mr. Page. (Law School.) Mr Eno.

**121. Surveying and Topographic Drawing.** Six credit hours First semester. Prerequisite, Mathematics 114 or 132, and Engineering Drawing 101. Mr. Waid.

The work will be divided into lectures, recitations, field work, computing, and drawing in such manner as the schedule and weather will permit.

**122. Thesis.** Four credit hours. Civil Engineering, fourth year, second semester. Prerequisite, Civil Engineering 119.

**123. Trusses.** Lectures, recitations, and drawing. Three credit hours. Mechanical Engineering, fourth year, first semester. Drawing the last three or four weeks. Prerequisite, Mechanics102 or 104. Mr. Morris, Mr. Hindman.

**124.** Repetition of course 123, Ceramic, Architecture and Mine Engineering third year, second semester. Concurrent Mechanics 102 or 104. Mr. Morris, Mr. Hindman.

**125. Tall Buildings.** Three credit hours. Three lectures weekly. Architecture, fourth year, first semester. Prerequisite, Civil Engineering 124. Mr. Morris.

**126. Timber and Masonry.** Two credit hours. Two lectures or recitations weekly. Mechanical Engineering, third year, second semester. Concurrent Mechanics 102. Mr. Hewerdine.

**128. Plane Surveying.** Two credit hours. One lecture and one field exercise of three hours per week. Architecture, fourth year, second semester, and Mechanical Engineering, second year, second semester. Prerequisite, Engineering Drawing 102, Mathematics 132. Mr. Hewerdine, Mr. Waid, Mr. McCall.

## FOR GRADUATES ONLY

For a complete description of the graduate work, the bulletin of the Graduate School should be consulted.

**201-202. Investigation and Design.** Three to ten credit hours. The year. Library, conference, and laboratory work. Time arranged with the instructor. Prerequisite, the permission of the instructor in charge. Work in Railroad and Transportation Engineering is conducted under the supervision of Mr. Sherman; in Bridge and Structural Engineering under Mr. Morris; in Municipal and Sanitary Engineering under Mr. Eno; in Stereotomy and Masonry Construction under Mr. Schlafly and Mr. Hewerdine

**203-204. Research Work.** Three to ten credit hours. The year. Library, conference, and laboratory work. Time arranged with the instructor. Prerequisite, the permission of the instructor. For division of the field and personnel, see Course 201-202.

# ELECTRICAL ENGINEERING

Office, Room 171, Robinson Laboratory

PROFESSORS CALDWELL, FLOWERS, MR. SHEPARDSON, MR. BROWN
MR. MOODY.

## EQUIPMENT

This department is located in the north end of the Robinson Laboratory. It has one large dynamo laboratory, 90 x 112 feet, and seventeen smaller rooms. There are also two long balconies used for drafting and computation.

Among the smaller rooms the following may be especially noted: The calibration room is well and conveniently fitted up with standards. These are kept accurate by frequent comparison at the National Bureau of Standards and are at the service of the electrical industries of the State.

Two telephone laboratories are separated by a sound-proof partition. They are well equipped with apparatus of different makes, including a set of Western Electric switchboard apparatus. There is also an artificial 50 mile line, comparison apparatus, and a 5-station 2-wire set loaned by the Automatic Electric Company, and used as an intercommunicating set for the department. The wireless telegraph laboratory has a two kilowatt sending station and good receiving apparatus.

The illumination laboratory is fitted for working with light or dark walls; there are two photometric outfits and illuminometers. The cable and iron testing laboratory is used for such work as requires galvanometers and other delicate apparatus. The battery room contains a 140-volt and an 8-volt high current battery, with end-cell switching arrangements, etc. There are two small shops fitted up for the construction and repair of apparatus by the department machinist. The necessary recitation rooms, offices, etc., are provided, and a museum with a collection of material illustrating applied electricity.

On the main floor is a space screened off for high potential work, where a 250,000-volt 50-kilowatt transformer forms a part of the equipment. Preparation has been made for apparatus suitable for running and testing in the laboratory a complete interurban car. The dynamo equipment of over seventy-five generators and motors, both alternating and direct current, aggregates over 800 horsepower capacity, and includes all important commercial types. A liberal equipment of measuring instruments of various kinds is available, including potentiometer, oscillograph, tachometers, frequency meters, etc.

## SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**101. Electrical Engineering.** Five credit hours. Three lectures and one four-hour laboratory period weekly. Chemical Engineering, and Mechanical Engineering, fourth year, first semester. Prerequisite, Physics 112 or Physics 114. Mr. Shepardson.

Lectures and laboratory work on direct and alternating current circuits, dynamo machinery, transformers, accumulators, and their applications.

**103. Electrical Engineering.** Three credit hours. Two lectures and one three-hour laboratory period weekly. Civil Engineering, third year, Mine Engineering, fourth year, first semester. Prerequisite, Physics 112, or 114. Mr. Flowers. Mr. Shepardson.

Lectures and laboratory work on direct current machinery, circuits, and transmission.

**104. Direct Current Machinery.** Five credit hours. Three lectures and one four hour laboratory period weekly. Electrical Engineering, third year, second semester. Prerequisites, Physics 135, Mathematics 142 and Mechanics 101. Mr. Flowers, Mr. Shepardson.

Generators and motors, their theory, construction, and operation. Lectures, recitations, problems, aud laboratory.

**106. Applications of Electricity.** Three hours for one-half semester. Three lectures per week. Electrical Engineering, third year, second semester. Prerequisites, Physics 135 and Mathematics 142. Mr. Caldwell.

A brief treatment of the uses of electricity, illumination, railways, mining, etc.

**108. Alternating Current Circuits and Machinery.** Three hours, for one-half semester. Electrical Engineering third year. Second half of second semester. Prerequisites, Mathematics 142, Physics 135, Mechanics 101; concurrent, Electrical Engineering 104. Mr. Caldwell.

General principles, circuits, generators and transformers,

**109. Alternating Current Machinery.** A continuation of Electrical Engineering 108. Three credit hours. Three lectures weekly Electrical Engineering, fourth year, first semester. Prerequisite, Electrical Engineering 108, and concurrent, Electrical Engineering 111.

Transformers, synchronous motors, induction motors, etc. Mr. Caldwell.

**111. Alternating Current Laboratory.** Three credit hours. Electrical Engineering, fourth year, first semester. Prerequisite, Electrical Engineering 108, concurrent, Electrical Engineering 109.

Alternating current, railway and telephone apparatus, accumulators. Mr. Brown.

**112. Advanced Alternating Current Laboratory.** Three credit hours. Electrical Engineering, fourth year, second semester. Prerequisite, Electrical Engineering 109 and 111. Mr. Brown.

**113. Electrical Railways.** Two credit hours. Electrical Engineering, fourth year, first semester. Alternative with Electrical Engineering 115, 117, and 119. Prerequisite, Electrical Engineering 104, concurrent, Electrical Engineering 109. Mr. Caldwell.

Systems, apparatus, and operation.

**115. Telephony.** Two credit hours. Electrical Engineering, fourth year, first semester. Alternative with Electrical Engineering 113, 117, and 119. Prerequisites, Electrical Engineering 104 and 108. Mr. Flowers.

Methods of operation, simple circuits and apparatus, elements of transmission theory.

**117. Electric Illumination.** Two credit hours. Electrical Engineering, fourth year, first semester. Alternative with Electrical Engineering 113, 115, and 119. Prerequisites, Electrical Engineering 104 and 108. Mr. Caldwell.

Principles of illumination, electric lamps, wiring plans, etc.

**119. Wireless Telegraphy.** Two credit hours. Electrical Engineering, fourth year, first semester. Alternative with Electrical Engineering 113, 115, and 117. Prerequisites, Electrical Engineering 104 and 108. Mr. Brown.

Elementary theory, production, transmission, and detection of damped and undamped oscillations.

**121. Electrical Design.** Three credit hours. Two three-hour drawing periods weekly. Electrical Engineering, fourth year, first semester. Prerequisite, Electrical Engineering 104. Mr. Flowers.

Direct current dynamos, transformers, etc.

**122. Electrical Design.** Two credit hours. A continuation of Electrical Engineering 121. Two three-hour drawing periods weekly. Electrical Engineering, fourth year, second semester. Elective. Mr. Flowers.

Alternating current apparatus.

**124. Electrical Transmission and Distribution.** Two credit hours. Two lectures weekly. Electrical Engineering, fourth year, second semester. Prerequisite, Electrical Engineering 109. Mr. Caldwell.

Systems, apparatus, and operation.

**125. Special Reading and Laboratory.** Credit hours to be arranged. Elective for fourth year Electrical Engineering and graduate students with consent of the instructor in charge. First semester. Prerequisites, Electrical Engineering 104 and 108.

**126. Special Reading and Laboratory.** A continuation of Electrical Engineering 125. Second semester.

**127. Thesis.** One credit hour. Electrical Engineering, fourth year, first semester. Prerequisites, Electrical Engineering 104 and 108.

**128. Thesis.** Five credit hours. Electrical Engineering, fourth year, second semester.

**130. Inspection Trip to the East.** April 26 to May 3, 1914. Electrical Engineering, third and fourth year. Given only in the even years.

Includes Pittsburg, Buffalo, Niagara, and Cleveland. The entire expense need not exceed $32. A satisfactory written report on the work of the trip and an examination are required.

**132. Inspection Trip West.** April 25 to May 2, 1915. Electrical Engineering, third and fourth year. Given only in the odd years.

Includes Chicago, Milwaukee, and Gary. The entire expense need not exceed $32. A satisfactory written report on the work of the trip and an examination are required.

**134. Reading Course.** Electrical Engineering, third and fourth years. This may be taken as a substitute for Electrical Engineering 130 on presentation of reasons satisfactory to the head of the department.

Assigned reading on processes of manufacture and power plants.

**136. Reading Course.** Electrical Engineering, third and fourth years. This may be taken as a substitute for Electrical Engineering 132 on presentation of reasons satisfactory to the head of the department.

## FOR GRADUATES ONLY

For a complete description of the graduate work, the bulletin of the Graduate School should be consulted.

**201-202. Advanced Alternating Current Machinery.** Two credit hours. The year. Mr. Caldwell.

An advanced course in the theory of alternating currents and alternating current apparatus.

**203-204. Transient Electrical Phenomena.** Two credit hours. The year. Mr. Flowers.

A course in the theory of the transient phenomena occurring in electrical machinery and transmission lines.

**205-206. Advanced Alternating Current Dynamo Laboratory.** Two credit hours. The year. Mr. Caldwell and Mr. Brown.

An advanced laboratory study of alternating current apparatus.

**207-208. Research Work.** Three to five credit hours. The year. Time to be arranged with the instructor. Prerequisite, permission of the instructor in charge. Library, conference, and laboratory work.

Research work in advanced alternating currents is given under the supervision of Mr. Caldwell and Mr. Brown; in dynamo design, under Mr. Flowers; in telephony, under Mr. Flowers; in illumination, under Mr. Caldwell; in wireless telegraphy, under Mr. Brown.

## ENGINEERING DRAWING

Office, Room 42, Brown Hall

PROFESSOR FRENCH, ASSISTANT PROFESSOR MEIKLEJOHN, MR. WILLIAMS, MR. HARPER, MR. SHEETS, MR. IVES, MR. TURNBULL, MR. GILBERT, MR. NORRIS

### EQUIPMENT

For Engineering Drawing there are four large, well lighted drawing rooms in Brown Hall and two in Hayes Hall, equipped with individual drawing tables and lockers, and two lecture rooms, with electric projection lantern. A blue print room is provided with electric light printing machine and sun frames. There is a good set of models illustrating intersections and warped surfaces, and a large collection of machine parts, small machines, patterns, core boxes and models, with a case of machinist's tools such as calipers, scales, surface gauges, etc., for use in machine sketching.

The department has an equipment of many special instruments for illustration and use, such as Universal drafting machines, Kelsey drafting rig, suspended pantograph, Ockerson machine, different types of section liners, lineads, curves, proportional dividers, protractors, special pens, etc.

Hand books, data sheets, catalogues and typical examples of shop drawings are available for student use.

The library contains an unusually extensive collection of books on descriptive geometry, machine design, graphics, perspective and lettering.

## SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**101. Elementary Mechanical Drawing.** Two credit hours. All four-year courses, first year, first semester. Mr. French and department instructors.

Practise in the use of drawing instruments, elementary projections.

**102. Mechanical Drawing.** Three credit hours. All four-year courses, first year, second semester. Prerequisite, Drawing 101, Lettering, orthographic, isometric, and oblique projections. Mr. French and department instructors.

**103. Descriptive Geometry.** Three credit hours. Two recitaions, one drawing period weekly. Ceramic, chemical, electrical, mechanical and mining engineering, second year, first semester. Prerequisite, Drawing 102, or 114. Mr. French and department instructors.

**104. Machine Sketching.** Three credit hours. One lecture, two drawing periods weekly. Ceramic, chemical, mechanical and mine engineering, second year, second semester. Prerequisite, Drawing 103. Mr. Williams, Mr. Sheets, Mr. Ives.

**105. Descriptive Geometry.** Three credit hours. Two lectures, one drawing period weekly. Civil Engineering, second year, first semester. Prerequisite, Drawing 102. Mr. Meiklejohn, Mr. Harper.

**106. Advanced Descriptive Geometry.** Three credit hours. Two lectures, one drawing period weekly. Civil Engineering, second year, second semester. Prerequisite, Drawing 105. Mr. Meiklejohn, Mr. Harper.

**107. Descriptive Geometry.** Three credit hours. Two recitations, one drawing period weekly. Architecture, second year, first semester. Prerequisite, Drawing 102. Mr. Meiklejohn.

**110. Technical Sketching.** Two credit hours. Electrical Engineering, second year, second semester. Prerequisite, Drawing 103. Mr. Williams, Mr. Sheets, Mr. Ives.

**111. Technical Drawing.** Two credit hours. Mechanical and Electrical Engineering, third year, first semester. Prerequisite. Drawing 104, or 110. Mr. Williams, Mr. Ives.

**113. Free-hand Drawing and Lettering.** Four credit hours. Short courses in Clay Working and Industrial Arts, first year, first semester. Short mining course, second year, first semester. Mr. Ives.

**114. Mechanical Drawing.** Three credit hours. Short courses in Clay Working, Industrial Arts, first year, second semester. Short mining, second year, second semester. Prerequisite, Drawing 113. Mr. Ives.

**115. Charcoal from Architectural Ornament.** Two credit hours. Architecture, second year, first semester. Mr. Norris.

**116. Pen Drawing.** Two credit hours. Architecture, second year, second semester. Mr. Norris.

**117. Water Color.** Three credit hours. Architecture, third year, first semester. Mr. Norris.

**118. Charcoal Drawing from the Antique.** Three credit hours. Architecture, third year, second semester. Prerequisite, Drawing 115. Mr. Norris,

**119. Clay Modeling.** Two credit hours. Architecture, fourth year, first semester. Prerequisite, Drawing 115. Mr. Lewis.

**121. Technical Drawing.** Two credit hours. Designing of chemical plants and machinery. Chemical Engineering, third year, first semester. Prerequisite, Drawing 104. Mr. Williams.

**122. Technical Drawing.** Two credit hours. Continuation of 121. Chemical Engineering, third year, second semester. Mr. Williams.

## ENGLISH

(Office, English Building)

PROFESSORS DENNEY, MCKNIGHT, GRAVES, ASSISTANT PROFESSORS DUNCAN, COOPER, HARRINGTON, BECK.

**101. Paragraph Writing: Description and Narration.** Two credit hours. First semester. Course 101 will be repeated in the second semester for the benefit of those who fail, the class meeting Saturdays at 9 a. m. Course 101 is also offered in the Summer Session.

**104. Paragraph Writing: Exposition and Argumentation.** Two credit hours. Second semester. Prerequisite, Course 101. Same hours as for Course 101. Course 104 is also offered in the Summer Session.

# GEOLOGY

Office, Room 1, Orton Hall

PROFESSORS PROSSER AND BOWNOCKER, ASSISTANT PROFESSOR HILLS, MR. MORSE, MISS MARK, MR. SCHROYER.

## EQUIPMENT

This department is located in Orton Hall and is noted for its fine museum of geological material. As the collections of the State Geological Survey are permanently located here, the material illustrative of Ohio formations is particularly complete. It is interesting in this connection to know that in the construction of the building a great variety of material coutributed from various quarries of Ohio was used. Thus the building itself forms an important part of the geological collections. Good opportunities are provided for the work in the lithologic, stratigraphic, and physiographic laboratories.

## SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**162. Elementary Physiography.** Four credit hours. Short mining, first year, second semester. Miss Mark.

The physiographic features of the earth's surface and the agencies producing them; the atmosphere; the ocean. Recitations, lectures map work, and field work.

**164. Elementary Geology.** Three credit hours. Short mining, second year, second semester. Mr. Morse.

Lithological, dynamical, structural, and historical geology. Recitations, lectures and laboratory work.

**165. General Geology.** Three credit hours. Mine Engineering, third year, first semester. Mr. Prosser, Mr Morse.

Structural, dynamical, and historical geology. The lectures are illustrated by maps, specimens, and lantern views. The common rock-forming minerals and rocks are studied in the laboratory. The first half of the semester, field trips Friday afternoon or Saturday morning will alternate with laboratory periods.

**166. Petrography.** Two credit hours. Mine Engineering, third year, second semester. Mr. Bownocker.

A study of hand specimens of igneous, metamorphic, and sedimentary rocks. Lectures and laboratory work.

**167. Economic Geology.** Three credit hours. Mine Engineering fourth year, first semester. Prerequisite, Geology 165-166. Mr. Bownocker.

The nature and origin of ores; their modes of occurrence and distribution. The non-metals, coal, oil, gas, clay, lime, cement and building stones. In the discussion of the non-metals emphasis will be laid on the products of Ohio.

**168. General Geology.** Three credit hours. Ceramic Engineering, fourth year; Civil Engineering, second year, second semester. Mr. Prosser, Mr. Hills, Mr. Morse.

Structural, dynamical, and historical geology. The lectures are illustrated by maps, specimens, and lantern views. The common rock-forming minerals and rocks are studied in the laboratory. The last half of the semester, field trips Friday afternoon or Saturday morning will alternate with laboratory periods.

## FOR GRADUATES ONLY

For a complete description of the graduate work, the bulletin of the Graduate School should be consulted.

**201-202. Advanced Historical Geology.** Three to five credit hours. The year. Time to be arranged. Laboratory open afternoons 1 to 4. Prerequisite, Geology 105, 106 107-108, 165 or 168, recommended. Mr. Prosser.

Advanced work in paleontology and stratigraphical geology. Field work to be arranged with individual students and it is recommended that a part of it be done during the summer vacation under the direction of the instructor in charge.

**203-204. Research Work.** Three to five credit hours. The year. Prerequisite, preceding courses in inorganic or historical geology. Field, laboratory, and library study is offered along two lines. Outline of work and time will be arranged with individual students. (a) STRATIGRAPHY AND PALEONTOLOGY. The investigation of some field problem in stratigraphy with laboratory and library study or of some special subject in paleontology. Mr. Prosser. (b) ECONOMIC GEOLOGY. The investigation of some field problem in petroleum, natural gas, coal, or salt. Mr. Bownocker.

## GERMAN

Offices, Rooms 317 and 318, University Hall
PROFESSORS EVANS, AND EISENLOHR, ASSISTANT PROFESSORS THOMAS, BARROWS, LEWISOHN, AND BUSEY, MR. WHYTE AND MR. RUDWIN.

**101-102. Elementary German.** Four credit hours. The year. Open to students in any four-year course who enter with a language other than German.

The essentials of grammar, the first semester.

Reading of easy narrative, grammatical drill, second semester.

**103. Intermediate German.** Four credit hours. Prerequisite, German 102, or two units entrance credit in German. Not open to students who enter with four units entrance credit in German.

Reading of narrative prose, with topical review of grammar. One hour prose composition weekly.

**106. Science Reading.** Four credit hours. Second semester. This course is for engineering students; a continuation of courses 103 and 107.

Rapid reading of German technical literature. Drill on sentence structure and word formation. The object of the course is to put students in the way of reading technical works and current technical literature.

**107. Advanced German.** Four credit hours. Open to first year students who enter with four units credit in German.

## INDUSTRIAL ARTS AND SHOPWORK

Office, Room 2, Hayes Hall
PROFESSOR SANBORN, ASSOCIATE PROFESSOR KNIGHT, MR. CROWE, MR. CASE, MR. BEEM, MR. DENMAN, MR. FOUST, MR. SMITH, MR. BRECKUR.

### EQUIPMENT

The carpenter and pattern shops are fitted with well designed benches, each containing a complete set of the necessary carpenter tools. There are also wood-turning lathes including an eight-foot pattern-maker's lathe. Among the power tools are planers of different kinds, and circular, scroll, and band saws. In the forge shop are the usual forges and anvils with the accompanying hand tools, and a number of special tools. Among these are a special gas furnace, foot-power hammer, drill, and a combined punch, shear and bar cutter. The foundry has a twenty-four-inch Colliau cupola, brass furnaces and a core oven. The room for chipping and filing contains the benches, hand tools and vises for such work, and a power-driven, sensitive drill and a wet tool grinder. The machine shop is furnished with lathes of various types, including a monitor turret lathe, planers, shapers, milling machines, grinding machines, and arbor presses. There is a good equipment of small tools, including a great variety of special ones.

## SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**101. Tools and Machines.** Three credit hours. Three recitations weekly. Short Industrial Arts, second year, first semester. Prerequisite, Mathematics 114 or 132. Concurrent, Physics 101.

Principles underlying the construction and operation of machines with a special study of machine tools.

**102.** Continuation of 101. Three credit hours. Three recitations weekly. Short Industrial Arts, second year, second semester. Mr. Sanborn.

**103. Designing.** Two credit hours. Two three-hour laboratory priods weekly. Short Industrial Arts, second year, first semester. Concurrent, Industrial Arts, 101. Mr. Sanborn.

**104.** Continuation of 103. Two credit hours. Two three-hour laboratory periods weekly. Short Industrial Arts, second year, second semester. Concurrent, Industrial Arts 102.

**110. Strength of Materials.** Six credit hours. Five recitations and one three-hour laboratory period weekly. Short Industrial Arts, second year, second semester. Mr. Sanborn.

Study of the strength of materials and their use in machines.

**112. Machine Design.** Two credit hours. Two two-hour periods weekly. Electrical Engineering, fourth year, second semester. Prerequisite, Mechanics 102, and Engineering Drawing 111. Mr. Sanborn.

Practical application of principles of machine design.

**114. Shop Building.** Two credit hours. Two recitations weekly. Alternative with Mechanical Engineering 146, fourth year, second semester. Prerequisite, Civil Engineering 126. Mr. Sanborn.

Lectures and problems on the construction of shop buildings and the arrangement of machinery; special shop appliances.

## SHOPWORK

(The classes in shopwork are carried under a different set of numbers from the preceding theoretical classes in Industrial Arts, though they are in the same department.)

**105. Foundry Work.** Two credit hours. One recitation and two two-hour laboratory perios dweekly. Mechanical Engineering, second year, first semester. Mr. Beem. Mr. Breckur.

Exercises and practise on tempering sand and preparing molds of machine parts in sand, core-making, melting iron and brass, and pouring.

**106.** Repetition of Course 105. Short Industrial Arts, first year, second semester. Mr. Beem. Mr. Breckur.

**107. Chipping and Filing.** Two credit hours. One recitation and two two-hour laboratory periods weekly. Mechanical Engineering, second year, first semester. Ceramic Engineering, and Short Clay-Working, alternative with 109 and 115. Mr. Knight. Mr. Case.

Exercises and practise in vise work including chipping in cast, and wrought iron, surface filing, squaring, fitting, finishing and the scraping of surface plates.

**108.** Repetition of Course 107. Short Industrial Arts, first year, second semester. Mr. Knight, Mr. Case.

**109. Joinery and Pattern-Making.** Two credit hours. One recitation and two two-hour laboratory periods weekly. Short Industrial Arts, first year, first semester. Ceramic Engineering and Short Clay-Working, alternative with Shopwork 107 and 115; Chemical Engineering, Electrical Engineering, Mechanical Engineering, and Mine Engineering, during the Summer Session at the close of the first year. Mr. Beem, Mr. Denman, Mr. Smith.

Exercises and practise in joinery, wood-turning, and pattern-making, including sawing, planing, mortising, framing, and other work involving the use of the ordinary carpenter tools, center and chuck turning, and making of finished patterns.

**110.** Repetition of Course 109. Mr. Beem, Mr. Denman, Mr. Smith.

**111. Advanced Pattern-Making.** One credit hour. One recitation and one two-hour laboratory periods weekly. Mechanical Engineering, second year, first semester. Prerequisite, Shopwork 109. Mr. Beem, Mr. Denman, Mr. Smith.

**112.** Repetition of Course 111. Short Industrial Arts, first year, second semester. Mr. Beem, Mr. Denman, Mr. Smith.

**113. Cabinet-Making.** Two credit hours. Two three-hour laboratory periods weekly. Elective, first semester. Prerequisite, Shopwork 109 or 110. Mr. Beem, Mr. Denman, Mr. Smith.

Exercises and practise in cabinet-making, including paneling, mitre and dove-tail joints; use of power tools.

**114.** Repetiton of Course 113. Elective, second semester. Mr. Beem, Mr. Denman, Mr. Smith.

**115. Forging.** Two credit hours. One recitation and two two-hour laboratory periods weekly. Short Industrial Arts, second year. first semester. Ceramic, Chemical, Electrical, Mechanical, and Mine Engineering, and Short Clay-Working, during the Summer Session at the close of the first year. Mr. Crowe, Mr. Foust.

The use and care of forge, fire, and tools. Practise in iron and steel forging, including such operations as cutting, bending, drawing upsetting, shaping and welding iron; the making, hardening and tempering of steel punches, chisels, and lathe tools.

**116.** Repetition of Course 115. Short Mining, first year, second semester. Mr. Crowe, Mr. Foust.

**118. Advanced Forging.** Two credit hours. Two three-hour laboratory periods weekly. Elective, second semester. Prerequisite, Shopwork 115. Mr. Crowe, Mr. Foust.

Various forms of welds in iron and steel; the use of scrolling irons and of forms for duplicating work; annealing; tool-making; case-hardening; tempering drills, dies and cutters; spring-making; ornamental iron work; visits to shops.

**119. Machine Work.** Three credit hours. One recitation and two three-hour laboratory periods weekly. Electrical Engineering and Short Industrial Arts, second year. Mr. Knight, Mr. Case.

Elementary exercises on the engine lathe, such as plain, straight, and taper turning, screw cutting, chucking, boring, filing and polishing, and the use of the drill press.

**120.** Repetition of Course 119. Mechanical Engineering, second year, second semester. Mr. Knight, Mr, Case.

**121. Advanced Machine Work.** Three credit hours. One recitation and two three-hour laboratory periods weekly. Mechanical Engineering, third year, first semester. Prerequisite, Shopwork 119 or 120. Mr. Knight, Mr. Case.

A continuation of Course 119 or 120 with more difficult exercises on the lathe, including square thread cutting, drilling, and tapping, use of steady rest, face-plate work and bar turning. Also practise on the milling machines, planer, shaper and turret lathe.

**122.** Repetition of Course 121. Electrical Engineering and Short Industrial Arts, second year, second semester. Mr. Knight, Mr. Case.

**123. Advanced Machine Work.** Two credit hours. Two three-hour laboratory periods weekly. Elective, first semester. Prerequisite, Shopwork 121 or 122. Mr. Knight, Mr. Case,

A more advanced course in milling machine work and grinding. Exercises in spur and spiral gear cutting, cam cutting, and differential and fractional indexing.

**125. Construction Work.** Two credit hours. First semester. Two three-hour laboratory periods weekly. Elective. Prerequisite, Shopwork 121 or 122. Mr. Knight, Mr. Case.

A course in construction work on any piece of apparatus or machinery which may be in course of construction in the shops.

**126.** Repetition of Course 125. Second semester. Elective. Mr. Knight, Mr. Case.

**127. Tool-Making and Jig Work.** Three credit hours. First semester. Elective. Prerequisite, Shopwork 123. Mr. Knight, Mr. Case.

**128.** Repetition of Course 127. Three credit hours. Elective, second semester. Mr. Knight, Mr. Case.

## FOR GRADUATES ONLY

For a complete description of the graduate work, the bulletin of he Graduate School should be consulted.

**201-202. Research Work.** Five to ten credit hours. The year. Library, conference and laboratory work. Time to be arranged with the instructor. Prerequisites, Physics 113, 114; Mechanics 101, 102; and Mechanical Engineering 127, 144, or Metallurgy 109, 110, and the permission of the instructor in charge.

Research work with special reference to the application of Physics, Chemistry, Metallurgy and Machine Design to the problems of the metal-working industries. This work is under the supervision of Mr. Sanborn and Mr. Knight.

## MATHEMATICS

Office, Room 314, University Hall

PROFESSORS BOHANNAN, MCCOARD, SWARTZEL, KUHN, ASSOCIATE PROFESSORS ARNOLD, RASOR, ASSISTANT PROFESSORS PRESTON, BAREIS, MORRIS, WEST; MISS RICKARD.

**101. Elementary Algebra.** Five credit hours. Five recitations weekly. Short Clay-working, Short Industrial Arts, and Short Mining, first year, first semester. Text-book, Wentworth's Algebra.

**102.** Continuation of Course 101. Five credit hours. Five recitations weekly. Short Clay-working, Short Industrial Arts, and Short Mining, first year, second semester. Prerequisite, Mathematics 101.

**113. Plane and Solid Geometry.** Five credit hours. Five recitations weekly. Short Clay-working, Short Industrial Arts, and Short Mining, first year, first semester. Text-book, Wells' New Geometry (1911).

**114. Solid Geometry and Plane Trigonometry.** Five credit hours. Five recitations weekly. Short Clay-working, Short Industrial Arts and Short Mining, first year, second semester. Prerequisite, Mathematics 113. Text-books: Well's New Geometry, and Taylor's Trigonometry.

**131. Trigonometry and College Algebra.** Five credit hours Five recitations weekly. All four-year courses in Engineering, first year, first semester. Prerequisites, Entrance Algebra and Geometry. Text-books: Bohannan's Trigonometry and Rietz and Crathorne's College Algebra.

This course is given in the second semester.

**132. Analytical Geometry and College Algebra.** Five credit hours. Five recitations weekly. All four-year courses in Engineering, first year, second semester. Prerequisite, Mathematics 131. Text-books: Candy's Analytical Geometry, and Rietz and Crathorne's College Algebra.

This course is given in the first semester and repeated in the Summer Session.

**141. Calculus.** Five credit hours. Five recitations weekly All four-year courses in Engineering, second year, first semester. Prerequisite, Mathematics 132.

This course is given in the second semester.

**142.** Continuation of Course 141. Five credit hours. Five recitations weekly. All four-year courses in Engineering, second year, second semester. Prerequisite, Mathematics 141.

This course is given in the first semester and repeated in the Summer Session.

**151. Differential Equations.** One credit hour. One recitation weekly. Mechanical Engineering, third year, first semester. Prerequisite, Mathematics 142. Text-book: Boyd's Differential Equations.

### FOR ADVANCED UNDERGRADUATES AND GRADUATES

Prerequisite: Differential and and Integral Calculus.

**163-164. Plane and Solid Analytical Geometry.** Three credit hours. The year. Mr. Morris.

**167-168. Differential Equations.** Three credit hours. The year. Mr. Rasor.

**173-174. Modern Higher Algebra.** Three credit hours. The year. Mr. Kuhn.

### FOR GRADUATES

**201-202.** (d) **Theory of Functions of a Complex Variable.** Three credit hours. The year. Mr. Bohannan.

**201.** (g) **Fourier's Series and Spherical Harmonics.** Three credit hours. First semester. Mr. Swartzel.

**202.** (v) **Vector Analysis and its Applications.** Three credit hours. Second semester. Mr. Swartzel.

## MECHANICAL ENGINEERING

Office, Room 244, Robinson Laboratory

PROFESSORS MAGRUDER AND HITCHCOCK, ASSOCIATE PROFESSOR JUDD, ASSISTANT PROFESSOR VALLANCE, MR. McCLELLAND, MR. BROWN, MR. TAPPAN.

### EQUIPMENT

The Department of Mechanical Engineering occupies the south end of the Robinson Laboratory. The main laboratory is 90 feet by 112 feet, and is divided into three sections. The steam-engineering section contains three 35-horsepower, horizontal, plain and automatic cut-off engines; one 60 horsepower tandem,compound, horizontal, automatic cut-off engine; one 10-horsepower two-cylinder, single-acting engine; one 30-horsepower tandem, compound, vertical engine with riding cut-offs and link motions; one 250-horsepower, cross compound vertical engine, with reheater, direct connected to a 20-inch centrifugal pump of 12,000 gallons per minute capacity; one 60-horsepower simple Corliss engine; one 15-horsepower vertical engine, and one 3-horsepower square-piston engine. Most of the above are arranged to be worked as condensing engines if desired, and are provided with surface condensers, air and circulating pumps, etc. The hydraulic section is equipped with eleven cisterns, a flume having a cross-section of thirteen square feet, submerged orifices up to thirty inches in diameter, a 30-foot well, and weirs capable of measuring up to 16,000 gallons per minute. It is provided with simple, compound, triplex, centrifugal, and rotary pumps, steam-turbine-driven centrifugal pump, pulsometer, turbine and impulse water-wheels, and a variety of apparatus specially adapted to study the flow of liquids. The third section contains Riehlê and Olsen testing machines for materials in tension, compression, bending, shear, and torsion; dynamometers for measuring the power supplied to machines; ventilating fans and the departmental machine shop. Supported by the columns carrying the sawtooth roof, and between the sections, are two galleries, each 8 feet by 108 feet. One of them is used as a drawing room; the other is used to study the flow of steam, air and water through pipes and bends.

Next to the steam laboratory is a section, 48 feet by 144 feet adapted for the operation and testing of steam boilers and gaspower machinery. The boiler laboratory is equipped with a horizontal, internally-fired tubular boiler;a horizontal return-flue boiler, exteriorly fired with brick setting; a locomotive boiler, and a 107-horsepower Babcock and Wilcox watertube boiler, provided with both an automatic stoker and a Dutch-oven furnace having shaking grates, and with forced, induced, and chimney drafts, a Foster independently-fired superheater, and a complete equipment of testing appliances. The gas-engine laboratory has three oil engines and three gas engines of 6 and 10 horsepower, one 10 horsepower, two-cylinder, two-cycle motor-boat gasoline engine; one 25-horsepower, two-cycle, and one 80-horsepower, two-cylinder, tandem, four-cycle, horizontal engine, each operated with either natural gas or producer gas; one 75-horsepower suction gas producer for use with either anthracite, or bituminous coals, with complete facilities for measuring the fuels, air, and water which are used and the power developed.

Between the boiler room and the electrical engineering laboratory is the demonstration amphitheater and lecture room. In the rear of the amphitheater is a spacious laboratory which is intended for the testing of locomotive machinery, and is connected by rail with the main tracks of the Hocking Valley Railroad, but which is as yet only partially equipped.

The two-story portion at the south end of the building is used for offices, three class rooms, an engineering museum, locker rooms, oil-testing laboratory, photographic dark-room, and instrument room.

## SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**101. Mechanism.** Three credit hours. Three recitations weekly. Electrical Engineering, third year, first semester. Prerequisites, Engineering Drawing 103, and Physics 114. Mr. Sanborn.

Recitations on the principles of mechanism and mechanical movements.

**103. Steam Power Plants.** Three credit hours. Three recitations weekly. Chemical, Electrical, and Mechanical Engineering, third year, first semester. Prerequisites, Engineering Drawing 104, and Physics 112. Mr. Magruder, Mr. Vallance.

A descriptive study of steam-generating and steam-using machinery.

**110. Mechanism and Machine Design.** Three credit hours. Three recitations weekly. Ceramic Engineering, Mechanical Engineering 171, fourth year, second semester. Prerequisites, Mechanical Engineeering 171 and Mechanics 102. Mr. Judd.

Recitations on the principles of mechanism, mechanical movements, and elementary machine design.

**114. Mechanism.** Three credit hours. Three recitations weekly. Mechanical Engineering, third year, second semester. Prerequisites, Engineering Drawing 104, and Physics 112. Mr. Sanborn.

Recitations and practise on the principles of mechanism and mechanical movements.

**116. Mechanism Drawing.** One credit hour. One three-hour drawing period weekly. Mechanical Engineering, third year, second semester. Prerequisite or concurrent, Mechanical Engineering 114. Mr. Sanborn.

Practise in laying out mechanisms and mechanical movements.

**118. Steam Engines.** Three credit hours. Three recitations weekly. Electrical and Mechanical Engineering, third year, second semester. Prereqnisites, Mechanical Engineering 103, and Mechanics 101. Mr. Magruder and Mr. Vallance.

**120. Steam Boilers.** One credit hour. One recitation weekly. Mechanical Engineering, third year, second semester. Prerequisites, Mechanical Engineering 103, and Mechanics 101. Mr. Magruder.

**121. Heating and Ventilating.** Two credit hours. Two recitations weekly. Architecture, fourth year, first semester. Prerequisite, Mechanics 101. Mr. Bradford.

Recitations and lectures on the principles and methods of heating and ventilation, with laboratory work and investigations of the heating and ventilating plants of different buildings.

**123. Materials of Construction.** Two credit hours. One recitation and one three-hour laboratory period weekly. Required in Architecture, fourth year, first semester. Prerequisite, Mechanics 101. Mr. Judd.

Lectures and recitations on the materials used in architectural and building construction, and laboratory exercises on their properties.

**125. Gas Engines and Producers.** Two credit hours. Two recitations weekly. Required in Mechanical Engineering, fourth year, first semester. Prerequisite, Mechanical Engineering 118. Mr. Magruder.

A study of gas-engines and of gas-producers as used for power purposes.

**127. Machine Design.** Five credit hours. Five recitations weekly. Required in Chemical and Mechanical Engineering, fourth year, first semester. Prerequisites, Engineering Drawing 104 and 111, Mechanics 102, Metallurgy 109, and Mechanical Engineering 103.. Mr. Magruder and Mr. Sanborn.

A detailed course of study based upon Mechanics and the materials of construction applied to the design and construction of machinery.

**129. Thermodynamics.** Two credit hours. Two recitations weekly. Required in Mechanical Engineering, fourth year, first semester. Prerequisite, Mechanical Engineering 118. Mr. Magruder.

The transmutations of heat and mechanical energies in steam and air engines, in air and ammonia compressors, and in refrigeration machines, together with a study of the tests of ideal and actual engines. and of their indicator diagrams; the flow of gases through pipes and orifices.

**130. Inspection Trip to the East.** April 26 to May 3, 1914. Required in Mechanical Engineering, third and fourth years. Concurrent, Mechanical Engineering 118. Given only in the even years. Mr. Magruder, and Mr. Judd.

Includes Pittsburg, Buffalo, Niagara Falls, Cleveland, and possibly other places. The entire expense need not exceed $32. A satisfactory written report upon the work of the trip and examination are required.

**132. Inspection Trip to the West.** April 25 to May 2, 1915. Required in Mechanical Engineering, third and fourth years. Concurrent, Mechanical Engineering 118. Given only in odd years. Mr. Magruder and Mr. Judd.

Includes Chicago, Milwaukee, Gary, and possibly other places. The entire cost need not exceed $32. A satisfactory written report upon the work of the trip and examination are required.

**134. Written Report.** Course of assigned reading upon processes of manufacture and power plants taken and reported upon by the third and fourth year students in Mechanical Engineering as a substitute for Mechanical Engineering 130 on presentation of reasons satisfactory to the head of the department. Mr. Magruder.

**136. Written Report.** Similar to Mechanical Engineering 134, as a substitute for Mechanical Engineering 132. Mr. Magruder.

**140. Mechanism and Machine Design.** Two credit hours. Two recitations weekly. Required in Civil Engineering, fourth year, second semester. Prerequisite, Mechanics 102. Mr. Sanborn.

An elementary course in the principles of mechanism and mechanical movements and the design of parts of machines.

**142. Hydraulic Machinery.** Two credit hours. Two recitations weekly. Required in Mechanical Engineering, fourth year, second semester. Prerequisites, Mechanics 102, and Mechanical Engineering 118. Mr. Judd.

A study of pumping machinery.

**144. Machine Design.** Five credit hours. Three recitations and two three-hour drawing periods weekly. Required in Chemical and Mechanical Engineering, fourth year, second semester. Prerequisite, Mechanical Engineering 127. Mr. Magruder and Mr. Sanborn.

A continuation of Course 127, with practical applications on the drawing board of the principles to the design of some particular machine.

**146. Steam Turbines.** Two credit hours. Two recitations weekly. Optional in Mechanical Engineering with Industrial Arts

114, fourth year, second semester. Prerequisite, Mechanical Engineering 129. Mr. Vallance.

A study of the generation of power by steam turbines, including auxiliary machinery.

**148. Thesis Work.** Three credit hours. Required in Mechanical Engineering, fourth year, second semester. Prerequisites, Mechanical Engineering, 125, 127, or 129. Mr. Magruder and Mr. Judd.

A special investigation or design based upon the work of the courses.

**160. Experimental Engineering Laboratory.** Two credit hours. One four-hour laboratory period weekly. Required in Electrical Engineering, third year, second semester. Concurrent, Mechanics 102, and Mechanical Engineering 118. Mr. Vallance and Mr. McClelland

Calibration of pressure gauges and indicator springs, steam engine indicator practise, testing of lubricating oils and the materials of construction.

**164. Experimental Engineering Laboratory.** Two credit hours. One four-hour laboratory period weekly. Required in Mechanical Engineering, third year, second semester. Concurrent, Mechanics 102, and Mechanical Engineering 118. Mr. Vallance and Mr. McClelland.

Calibration of pressure gauges and indicator springs; steam-engine indicator practise; testing of oils and the materials of construction.

**171. Experimental Engineering Laboratory.** Four credit hours. Two recitations and one four-hour laboratory period weekly. Required in Ceramic Engineering, fourth year, first semester. Prerequisite, Mechanics 102. Concurrent, Metallurgy 109. Mr. Judd, Mr. Vallance, and Mr. McClelland.

Lectures and recitations on power transmissions, steam and gas engines, and boilers. Laboratory work in the calibration of pressure gauges and indicator springs; valve setting; testing of steam and gas engines; testing of steam and centrifugal pumps; boiler and fuel trials.

**173. Experimental Engineering Laboratory.** Five credit hours. One recitation and two four-hour laboratory periods weekly. Required in Civil Engineering, fourth year, first semester. Prerequisite, Mechanics 102. Mr. Judd, Mr. Vallance, and Mr. McClelland.

Practise in the testing of the materials of construction; calibration of orifices and weirs; study of the flow of liquids and gases; tests of steam, power, rotary, and centrifugal pumps; tests of water motors and turbine water-wheels. Lectures and recitations on same and on steam engines, boilers and transmission machinery.

**175. Experimental Engineering Laboratory.** Three credit hours. One six-hour laboratory period weekly. Required in Electrical Engineering, fourth year, first semester. Prerequisite, Mechanical Engineering 118 and 160. Mr. Judd, Mr. Vallance, and Mr. McClelland.

Tests of steam engines and boilers; gas and oil engines; steam and power pumps; hydraulic experimentation; and the use of transmission and absorption dynamometers.

**179. Experimental Engineering Laboratory.** Two credit hours One four-hour laboratory period weekly. Required in Mechanical Engineering, fourth year, first semester. Prerequisite, Mechanical Engineering 164. Concurrent, Mechanical Engineering 125 and 129. Mr. Judd, Mr. Vallance, and Mr. McClelland.

Valve setting, moisture determinations in steam, gas calorimetry, measurements of flow of water by means of orifices, nozzles, weirs, and venturi-meter; tests of belts with use of transmission and absorption dynamometers.

**190. Experimental Engineering Laboratory.** Six credit hours. Four three-hour laboratory periods weekly. Required in Mechanical Engineering fourth year, second semester. Prerequisites, Mechanical Engineering 125, 129 and 179. Mr. Judd, Mr. Vallance, and Mr. McClelland.

Tests of steam and hot air engines; steam boilers; gas and oil engines; gas producers; air compressors; injectors and pulsometers; centrifugal, rotary, and power pumps; hydraulic rams, impulse and turbine water wheels; fans and blowers, and steam turbines.

**192. Experimental Engineering Laboratory.** Three credit hours. One recitation weekly and one four-hour laboratory period weekly. Required in Mine Engineering, fourth year, second semester. Prerequisites, Mechanics 102, and Metallurgy 109. Mr. Judd, Mr. Vallance. and Mr. McClelland.

Lectures and recitations on power transmission, steam and gas engines, steam boilers, and gas producers. Laboratory work in the calibration of pressure gauges and indicator springs; valve setting; testing of steam engines; testing of steam and centrifugal pumps; boiler and fuel trials; tests of gas engines and gas producers.

### FOR GRADUATES ONLY

For a complete description of the graduate work, the bulletin of the Graduate School should be consulted.

**201-202. Research Work.** Five to ten credit hours. The year. Library, Conference and Laboratory work. Time arranged with the instructor. Prerequisite, the permission of the instructor in charge.

Research work in gas enginry is conducted under the supervision of Mr. Magruder; in steam enginry and fuel testing, under Mr. Hitchcock; in applied hydraulics, under Mr. Judd.

## MECHANICS

Office, Room 233, Lord Hall

PROFESSOR J. E. BOYD, PROFESSOR CODDINGTON, MR. NEILAN

### EQUIPMENT

The Department of Mechanics occupies rooms in the Mines Building. The equipment consists of apparatus for a limited number of class room experiments designed to illustrate the fundamental facts of the science. It includes pulleys, platform scales, spring balances, a three-foot graduated circle for resolution of forces, apparatus for demonstrating couples in parallel planes, a chain for catenary experiments, model for shear and moment in beams, and apparatus for measuring acceleration and accelerating force.

The Department has a set of special extensometers for determining the maximum stress in bridge columns, and a second set for photographically recording the stresses due to moving trains. These are used jointly with the Department of Civil Engineering in thesis investigations.

The laboratory work in strength of materials, involving the use of testing machines, is given at present in the Department of Mechanical Engineering.

### SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**101. Statics and Strength of Materials.** Five credit hours. Architecture, Ceramic, Chemical, Civil, Electrical, Mechanical and Mine Engineering, third year, first semester. Prerequisite, Mathematics 142.

**102. Strength of Materials, continued, Kinetics and Hydraulics.** Five credit hours. Chemical, Civil, Electrical, Mechanical and Mine

Engineering, third year, second semester. Prerequisite, Mechanics 101.

**104. Strength of Materials.** Two credit hours. Architecture and Ceramic Engineering, third year, second semester. Prerequisite, Mechanics 101.

### FOR GRADUATES ONLY

For a complete description of graduate work, the bulletin of the Graduate School should be consulted.

**201-202. Advanced Theoretical Mechanics.** Three credit hours. The year.

Library and Conference work. Time to be aranged with the instructor. Prerequisite, Mechanics 101-102, and the permission of the instructor in charge. This work is done under the supervision of Mr. Boyd and Mr. Coddington.

## METALLURGY AND MINERALOGY

Office, Room 100, Lord Hall

PROFESSOR SOMERMEIER, AND ASSISTANT
PROFESSORS DEMOREST AND MCCAUGHEY.

### EQUIPMENT

The equipment of this department is unusually complete. It occupies about 14,000 square feet of floor space at the east end of the basement and first floor of Lord Hall. In addition to the lecture rooms, there are separate laboratories for the following lines of work: For the analysis and assaying of iron, steel, ores, and furnace products by wet methods; for fire assaying and testing of gold and silver ores, equipped with furnaces and cyanide plant; for general and determinative mineralogy, equipped for blowpipe analysis and for the microscopic examination of minerals; for the calorimetric examination of coals and other fuels, technical gas analysis and the examination of mine air; for the microscopic examination and thermal tests of metals; and for the analysis and complete examination of coals. There is also a crushing and sampling plant for experimental tests on ores and minerals. The department now has a complete model New Century coal jig, a small experimental ore jig, and other apparatus for the practical testing of coal and ores by washing methods. The museum contains a large number of specimens and is being constantly developed.

## SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**102. Mineral Chemistry.** Four credit hours. Short Mining, second year, second semester. Prerequisite, Chemistry 101. Mr. Demorest and Mr. Minor.

A course of lectures upon mine gases, safety lamps, mine explosions, boiler water, mine water, water supply, explosives, coal and coke.

**104. Crystallography and Mineralogy.** Three credit hours. Mine Engineering, second year, and Chemical Engineering, third year, second semester. Prerequisite, Chemistry 106. Mr. McCaughey.

Lectures on Crystallography, Physical and Decriptive Mineralogy. Illustrated by drawings, models and mineral specimens.

**105. Fire Assaying.** Three credit hours. Mine Engineering, third year, first semester. Laboratory, two afternoons per week. Monday and Tuesday, or Thursday and Friday. Prerequisite, Metallurgy 106, or equivalent. Mr. McCaughey.

Lectures and laboratory work. Practical work in the assaying of gold, silver, and lead ores.

**106. Metallurgical Analysis.** Four credit hours. One lecture, nine hours laboratory weekly. Mine Engineering, second year, second semester. Prerequisite, Chemistry 106 or 110, and Chemistry 119. Mr. Demorest.

Lectures and laboratory work. Laboratory work in the analysis of iron ores, iron and steel, fuel and slags, and ores of lead, zinc, and copper by wet methods, using approved methods as practised in technical laboratories and metallurgical works.

**107. Alloy Analysis.** Four credit hours. One lecture, nine hours laboratory weekly. Mine Engineering, third year, first semester. Prerequisite, Metallurgy 106. Mr. Demorest.

Lectures and laboratory work. Laboratory work in the analysis of alloy steels, such as vanadium, tungsten, chronium, nickel and molybednum steels, and other alloys. Quantitative work preceded by qualitative tests on the alloys.

**108. Determinative Mineralogy.** Three credit hours. One lecture two three-hour laboratory periods weekly. Mine Engineering, third year, second semester. Prerequisite, Metallurgy 104. Mr. McCaughey.

Lectures and laboratory work in practical determination of minerals by physical and chemical tests. Each student is furnished with a set of apparatus and works under an instructor's inspection. Brush and Penfield's Determinative Mineralogy is used as a manual.

**109. General Metallurgy.** Four credit hours. Mine Engineering, Mechanical Engineering, Chemical Engineering, third year, first semester. Ceramic Engineering, fourth year, first semester. Prerequisites, Chemistry 106, and Physics 114. Mr. Somermeier, Mr. Demorest.

Lectures and recitations on general metallurgy, fuels, iron and steel, their properties and manufacture.

**110. Metallurgy of Non-Ferrous Metals.** Four credit hours. Mine Engineering, third semester. Mr. Somermeier.

Lectures and recitations on the metallurgy of the non-ferro metals; copper, lead, gold, silver, etc. Their properties, reduction and purification.

**111. Metallurgical Construction.** Two credit hours. Mine Engineering, fourth year, first semester. Prerequisites, Drawing 111, Mechanics 102, Metallurgy 109 and 113. Mr. Somermeier, Mr. Minor

Lectures and drawing room practise on the designing of furnaces and metallurgical plants.

**112. Technical Gas Analysis.** Two credit hours. Mine Engineering, third year, second semester. Two afternoons per week. Prerequisites, Metallurgy 106, 109 or equivalent. Mr. Demorest.

Laboratory work supplemented by lectures. Technical analysis of metallurgical and mine gases. Determination of the calorific value of gases; problems involving application of results of gas analysis to furnace operation, mine ventilation, etc.

**113. Ore Dressing and Coal Washing.** Two credit hours. Mine Engineering, fourth year, first semester. Prerequisite, Metallurgy 109. Mr. McCaughey.

Methods of concentrating and enriching ores and fuels by mechanical means. Lectures with references to standard books and various papers in technical journals.

**114. Special Metallurgy.** Three credit hours. Mine Engineering fourth year, second semester. Hours to be arranged. Prere uisites, Metallurgy 106, 107, 109, 110, or equivalent. Mr. Somermeier.

Lectures and laboratory, supplemented by lectures on microscopic examination of metals, study of properties of alloys, testing of metallurgical processes, pyrometry, and high temperature measurements, calorimetry, and other tests on fuels.

**116. Thesis.** Three credit hours. Second semester.

**117. Advanced Crystallography and Physical Mineralogy.** Three credit hours. First semester. Two lectures and one laboratory period. Mr. McCaughey.

The study of the geometrical and physical properties of crystals. Laboratory work on the measurement, calculation and projection of crystals and the determination of physical and optical constants of crystallized bodies. Prerequisites, Physics and Chemistry.

**118. Microscopic Mineralogy.** Three credit hours. Second semester. One lecture and two laboratory periods. Mr. McCaughey.

The use of the polarizing microscope in the identification of minerals in fine powder and in thin section. Determination of the optical constants of minerals and crystallized bodies with a polarizing microscope. Prerequisites, Metallurgy 104, Physics and Chemistry.

### FOR GRADUATES ONLY

For a complete description of the graduate work, the bulletin of the Graduate School should be consulted.

**201. Research Work.** Three to five credit hours. First semester. Library, Conference and Laboratory work. Time arranged with the instructor. Prerequisite, the permission of the instructor in charge. These courses are under the supervision of Mr. Somermeier and Mr. Demorest.

(a) **Iron, Steel and Other Alloys.** Investigations on the composition, properties, structure and heat treatment. Prerequisite, Metallurgy 114.

(b) **Fuels.** Investigations on composition, conservation and utilization. Prerequisite, Metallurgy 114.

(c) **Investigations on the Metallurgy and Analysis of the Less Common Metals**, as tin, antimony, bismuth, tungsten, etc. Prerequisites, Metallurgy 106 and 109.

(d) **Investigation of Special Metallurgical Processes**, as the electrolytic refining of lead, etc. Prerequisites, Metallurgy 100 and 109.

## MILITARY SCIENCE AND TACTICS

Office, The Armory

CAPTAIN GEORGE L. CONVERSE, U. S. A., RETIRED

In accordance with the Morrill Act, passed in 1865, under which the University was established, military instruction must be included in the curriculum. The Board of Trustees therefore requires all male students, unless excused by the Military and Gymnasium Board, to drill during two years. The work is under an officer of the regular army, detailed for the purpose. The Military Department is open during five days each week throughout the year.

## EQUIPMENT

The equipment of the Military Department comprises 1000 standard U. S. Magazine rifles, with belts, bayonets and accoutrements, 51 regulation infantry officers' sabres and belts, 25 cadet swords and belts, a stand of regimental colors, with markers, guidons, etc. The target practise equipment comprises 6 Springfield gallery rifles and 7 Winder model Winchester gallery rifles, 5 targets for 100, 200 and 300 yards, and 5 Winder-Model targets for long range. The band comprises about 60 pieces, partly supplied by the University and partly owned by the members.

The office is equipped for recording the attendance and performance of each cadet in drill, target practice and class-room work.

## ORGANIZATION

Cadet regiment is organized into three battalions of four companies each, a band, and a trumpet corps. Each battalion has its own staff officers. The total number of men under arms averages about one thousand at present. Service in the band is credited as military service. The appointment of cadet officers during the second year of service is for excellence in their work. These officers may continue to serve during the third and fourth years if they wish, and if they do, are given compensation at the end of each year's satisfactory service amounting to not less than $25.00 for lieutenants, $30.00 for captains, and larger sums for officers of higher ranks. Members of the band who volunteer for service after having completed their two years required duty are also paid at the rate of $20.00 per year, and receive instruction during the four winter months from a competent band-master.

## SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**1. Military Drill.** One credit hour. Five months, three hours per week (divided between fall and spring) military drill; four months three hours per week, (winter) of class-room instruction in drill regulations. Target practise at any open hour during the afternoons of the winter months, at 100, 200 and 300 yards. Lecture, one hour weekly, by the President, upon topics of common interest to the student body.

**2. Military Drill.** One credit hour. Five months, three hours per week, (divided between fall and spring), in extended order and guard duty. Four months, three hours per week (winter) of classroom instruction in Articles of War, guard manual and field service, regulations. Target practise, at any open hour of the afternoons of the winter months, at 500, 600 and 800 yards.

**Note**—New students entering the University are cautioned not to buy uniforms until so instructed by the Commandant. Second hand uniforms are rarely accepted.

## MINE ENGINEERING

Office, Room 200, Lord Hall

PROFESSOR RAY, ASSISTANT PROFESSOR MINOR

### EQUIPMENT

The department occupies the east end of the second floor of the School of Mines Building and one basement room, and has a floor space of 6000 square feet. This includes the office of the department, a large lecture room, a drawing room with accommodations for fifty students, a blue-print room with full equipment for both sun and electric light printing, a laboratory for safety lamp testing and other special work, and in the basement a large room for work in ventilation.

The equipment includes all of the latest improved instruments and apparatus used in mine surveying and mine ventilation. There are a variety of surveying instruments for general practise, also targets, plummet lamps, etc., for mine and tunnel work. The laboratory contains apparatus for the testing and an outfit for the repair of safety lamps; and practise tests are made with the lamps for the detection and estimation of fire damp. An outfit for special analytical, chemical and mineralogical work is also available for use at all times. A growing collection of models of mines, smelters, ore dressing plants, coal tipples, metal head frames, split construction and the various types of framing are used in connection with the lectures and are kept in the museum for the use of the students. For the practical study of ventilation the equipment is complete, aud includes anemometers, water gauges, barometers, barographs, polymeters, registers, etc; most of which are self-recording; there are also a portable gas apparatus and various forms of rescue apparatus.

## SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**101. Mine Engineering.** Five credit hours. Lectures and field practise. Short Course in Mining, second year, first semester. Prerequisite, Mathematics 114. This course is similar to Course 103, but more elementary. The same text is used. The students have more practise in the drawing room. Mr. Minor.

**102. Mine Engineering.** Five credit hours. Short Course in Mining, second year, second semester. Prerequisites, Mine Engineering 101 and Physics 101. Lectures illustrated by experiments, and maps of mines and models when possible; tests by safety lamps and anemometers; methods of air distribution in coal mines. Mr. Minor.

**103. Mine Engineering.** Mine Surveying. Four credit hours, Mine Engineering, second year, first semester, and Ceramic Engineering, third year, first semester. Prerequisites, Engineering Drawing 104, and Mathematics 132. Field practise in the use of instruments for surface and underground surveys. Field notes are taken and maps and plans made in the drawing room. Mr. Ray, Mr. Minor.

**104. Mine Engineering.** Plans and Specifications. Four credit hours. Mine Engineering, fourth year, second semester. Prerequisite, Mine Engineering 105, and Metallurgy 111. Practise in designing mine plants, drafting and estimating. Mr. Ray, Mr. Minor.

**105. Mine Engineering.** Five credit hours. Mine Engineering, fourth year, first semester. Prerequisites, Mechanics 102, Mine Engineering 103 and Geology 165. Lectures on mine operating, mining machinery, ventilation, shaft sinking, working out deposits, etc. Constant reference is required to standard works and to the leading technical journals. Mr. Ray.

**106. Mine Engineering.** Five credit hours. Mine Engineering, fourth year, second semester. Prerequisite, Mine Engineering 105. A continuation of Mine Engineering 105. Mr. Ray.

**107. Mine Engineering.** Two credit hours. Two two-hour drawing periods weekly. Short Mining, second year, first semester. Mine Engineering 101, concurrent. Mr. Minor.

**109. Mine Trip.** One credit hour. First semester. Mr. Minor.

**110. Mine Trip.** One credit hour. Second semester. Mr. Minor.

**116. Thesis.** Three credit hours. Second semester. Mr. Ray Mr. Minor.

## FOR GRADUATES ONLY

For a complete description of the graduate work, the bulletin of the Graduate School should be consulted.

**201-202. Research Work.** Three to five credit hours. The year Library, conference, laboratory and field work. Time arranged with the instructor. Prerequisite,the permission of the instructor in charge.

Mine accidents; preventive regulations; statutory provisions; mine fires; mine explosions; gas indicators; rescue operations; rescue appliances. This work is under the supervision of Mr. Ray and Mr. Minor.

## PHYSICAL EDUCATION FOR MEN

Office, The Gymnasium

PROFESSOR WINGERT, MR. OHLSON, MR. BARTHOLOMEW.

### EQUIPMENT

The University recognizes the need for the physical as well as the mental development of the students and provides the necessary means to meet this need. The work is done under a Director, who is a graduate physician and a member of the Faculty.

### SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**1. Physical Education.** One credit hour. Two hours per week for one year. (a) Lectures on personal hygiene and physiology of exercise one hour a week, first eight weeks, first semester. (b) Corrective: A graded course of free hand exercise, stretching, relaxing, stimulating, exercise with light hand apparatus for the relief and correction of slight body defects, deformities, improper carriage, etc. (c) Educative:Graded progressive exercise on the apparatus and mats to promote muscular tone, vigor, vitality,endurance. (d) Recreative: Gymnasium games, mental relaxation, non-competitive exercises.

**2. Advanced Exercises.** Elective. (a) Advanced exercises on the apparatus and mats. (b) Combative exercises—boxing, fencing, wrestling. A small charge is made to those electing this work. (c) Recreative: Football, baseball, basketball, tennis, track and field sport, cross-country running, etc. Special hours are arranged for those electing the above exercise and credit is given in the regular course.

# PHYSICS

Office, Room 24, Physics Building

PROFESSORS COLE, EARHART, BARNETT, ASSISTANT PROFESSORS SHEARD AND SMITH, MR. HEIL, MR. WEIMER, MR. SMITH, AND DEPARTMENT FELLOWS.

## EQUIPMENT

This science, upon the principles of which so much of the work of all classes of engineers is based, is well housed in the Physics Building. A lecture room, capable of seating 250 students, and with fine equipment, is used for the lectures of the second year. This course also includes recitations and laboratory work. The equipment for the latter permits each student to perform experiments illustrating the work covered in class. For the special laboratory work in mechanics and heat the equipment is good, including apparatus for showing the composition of forces, acceleration of gravity, balances, chronometers chronographs, cathetometers, calorimeters, and various other forms of heat apparatus. In electricity and magnetism, upon which the work of the electrical engineering course so largely depends, the equipment is unusually complete, including, besides the necessary galvanometers, resistance boxes, voltmeters, ammeters, wattmeters, etc., many special instruments such as oscillographs, potentiometers, photometric apparatus and watt-hour meters. The laboratories for this work are located in the basement and are liberally provided with slate-capped brick piers and wall brackets which give excellent conditions for the use of galvanometers. The laboratories are thoroughly wired, and a large storage battery as well as a motor generator set and mercury vapor converter furnish current.

## SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**101. Elementary Physics.** Six credit hours. Five recitations and lectures, one three-hour laboratory period weekly. Short Clayworking, second year, first semester. Short Mining, first year, first semester. Text-book, Millikan and Gale's Elements of Physics. Mr. Heil.

**111. General Physics.** Three credit hours. Two lectures, one recitation, and one two-hour laboratory period weekly. Architecture, Chemical, Civil, and Mine Engineering, second year, first semester

Prerequisites, Preparatory Physics and Mathematics 132. All instructors. Lectures by Mr. Cole.

**112.** Continuation of Physics 111. Three credit hours. Two lectures, one quiz, and one two-hour laboratory period weekly. Chemical, Civil, Mine, and Mechanical Engineering. Prerequisite, Physics 111. All instructors. Lectures by Mr. Cole.

**113. General Physics.** Mechanics and Heat. Five credit hours. Two lectures, three recitations, and one two-hour laboratory period weekly. Ceramic, Electrical, and Mechanical Engineering, second year, first semester. Prerequisites, Preparatory Physics and Mathematics 132. All instructors. Lectures by Mr. Cole.

**114. General Physics.** Electricity, Light and Sound. A continuation of Physics 113. Five credit hours. Two lectures, three recitations, and one two-hour laboratory period weekly. Ceramic and Electrical Engineering, second year, second semester. Prerequisite, Physics 113. All instructors. Lectures by Mr. Cole.

**133. Physical Laboratory.** Two credit hours. Two two-hour laboratory periods weekly. Electrical Engineering, second year, first semester. Concurrent, Physics 113. Mr. Smith. Mr. Heil.

**134. Electrical Measurements and Photometry.** Three credit hours. Two three-hour laboratory periods weekly. Electrical Engineering, second year, second semester. Concurrent, Physics 114. Mr. Barnett. Mr. Weimer.

**135. Electrical Measurements and Photometry.** Five credit hours. Three three-hour laboratory periods weekly. A continuation of Physics 134. Electrical Engineering, third year, first semester. Prerequisites, Physics 114 and 134, and Mathematics 141-142. Mr. Barnett. Mr. Weimer.

**137. Physical Laboratory.** Three to five credit hours. Prerequisite or concurrent, Physics 111. Elective.

**138. Physical Laboratory.** Two credit hours. Two two-hour laboratory periods weekly. Mechanical Engineering, second year, second semester. Prerequisite, Physics 111; Concurrent 112. Elective, three to five credit hours. Mr. Smith. Mr. Heil.

**139-140. Advanced Electrical Measurements.** Three to five credit hours. The year. Elective. Prerequisite, Physics 135 or equivalent. Mr. Barnett.

This course is subject to considerable variation to meet the needs of individual students, but a large amount of time is always devoted to oscillograph work.

### FOR GRADUATES AND ADVANCED UNDERGRADUATES

For a complete description of the graduate work, the bulletin of the Graduate School should be consulted.

**123-124. Advanced Laboratory.** Three to five credit hours. The year. Prerequisite, Physics 121-122. Mr. Cole.

**144. Electricity.** Three credit hours, second semester. Prerequisite, Physics 103-104 or 105-106; calculus precedes or accompanies. Mr. Earhart

### FOR GRADUATES ONLY

***203-204. Theoretical Mechanics.** Three credit hours. The year. Prerequisites, Physics 105-106, and Mathematics 141-142, or equivalents. Mr. Blake.

**205-206. Thermodynamics, and Electrolytic Conduction.** Two credit hours. The year. Prerequisites, Physics 105-106, and Mathematics 141-142, or equivalents. Mr. Smith.

***207-208. Theory of Electricity and Magnetism.** Three credit hours. The year. Prerequisites, 105-106, and Mathematics 141-142 or equivalents.

**211-212. Theory of Oscillations with Applications to Wireless Telegraphy.** Two credit hours. The year. Prerequisites, Physics 105-106, and Mathematics 141-142, or equivalents. Alternates with 213-214. Mr. Blake.

**215-216. Electromagnetic Theory.** Three credit hours. The year. Mr. Barnett.

## ROMANCE LANGUAGES AND LITERATURES

Office, Room 305, University Hall

PROFESSORS BOWEN AND BRUCE, ASSOCIATE PROFESSOR INGRAHAM, ASSISTANT PROFESSOR HAMILTON, MR. CHAPIN, MR. ROCKWOOD, MR. BOND, MR. ——

### I. FRENCH

**101-102. Elementary French.** Four credit hours. The year. Four recitations weekly, first year. May be taken by students in any four-year course who enter with no entrance credits in French. Textbooks: Fraser and Squair's Grammar, or equivalent, and Aldrich and

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*Not given in 1913-1914.

Foster's or Bowen's First Scientific Reader. Followed by historical and narrative prose; one or more prose comedies.

**103. Modern French Literature.** Four credit hours. Four recitations weekly, first year, first semester. May be taken by first year students in any four-year course who enter with two units entrance credits in French. Prerequisite, French 101-102, or two units entrance credits.

Nineteenth Century Prose, including (1) contes, (2) the novel (Balzac or Hugo). Prose composition, with practise in speaking. Systematic attention given to syntax and idiom.

**106. Science Reading.** Four credit hours. Four recitations weekly, first year, second semester. Must be taken by students in Engineering who take French 103 during the first semester.

A course of rapid reading introductory to the vocabulary of scientific literature.

## II. SPANISH

**101-102. Elementary Spanish.** Four credit hours. The year. Four recitations weekly, first year. May be taken by students in any four-year course who enter with no entrance credits in Spanish. Grammar, Ingraham-Edgren's or equivalent, and Ingraham's Victoria y Otros Cuentos. Easy Prose and Plays. Composition and practise in speaking.

**103-104. Modern Spanish Literature.** Four credit hours. The year. Four recitations weekly. May be taken by students who enter with two units entrance credits in Spanish. Prerequisite, Spanish 101-102, or two units entrance credits.

The novel and drama of the nineteenth century. Lectures covering a survey of the literature. Composition and practise in speaking continued.

## SHOPWORK

(See Industrial Arts)

## SPANISH

(See Romance Languages)

# ENROLMENT

November 1, 1912.

| | |
|---|---|
| Students in Four-Year Courses Leading to Degrees | 746 |
| Students in Short Courses not Leading to Degrees | 15 |
| Special Students | 6 |
| Total | 767 |

### Classification by Courses

| Name of Course Pursued | 4th year | 3d year | 2d year | 1st year | Unclassified | Total |
|---|---|---|---|---|---|---|
| First Year (Four-Year Courses) | .... | .... | .... | 256 | .... | 256 |
| Architecture | 11 | 10 | 20 | .... | .... | 41 |
| Ceramic Engineering | 10 | 10 | 10 | .... | .... | 30 |
| Chemical Engineering | 11 | 22 | 32 | .... | .... | 65 |
| Civil Engineering | 31 | 30 | 41 | .... | .... | 102 |
| Electrical Engineering | 28 | 34 | 46 | .... | .... | 108 |
| Mechanical Engineering | 21 | 41 | 51 | .... | .... | 113 |
| Mine Engineering | 13 | 9 | 9 | .... | .... | 31 |
| Special | .... | .... | .... | .... | 6 | 6 |
| Clayworking (Short) | .... | .... | .... | 3 | ... | 3 |
| Industrial Arts (Short) | .... | .... | 1 | 6 | .... | 7 |
| Mining (Short) | .... | .... | .... | 5 | .... | 5 |
| Total | 125 | 156 | 210 | 270 | 6 | 767 |

# GRADUATES

(November 1st, 1912)

**Classification by Courses**

| NAME OF COURSES | DEGREE CONFERRED | NUMBER OF GRADUATES | |
|---|---|---|---|
| Architecture | C. E. (in Arch.)<br>B. Arch | 19<br>8 | 27 |
| Ceramic Engineering | E. M. (in Cer.)<br>Cr. E. | 13<br>69 | 82 |
| Chemical Engineering | B. Sc. (in Chem.)<br>B. Sc. (in Chem. Eng.) | 44<br>28 | 72 |
| Civil Engineering | C. E. | | 319 |
| Electrical Engineering | M. E. in E. E. | | 331 |
| Industrial Arts | B. Sc. (I. A.) | | 6 |
| Mechanical Engineering | M. E. | | 247 |
| Mine Engineering | E. M. | | 152 |
| Advanced Degrees | M. Sc.<br>D. C. E. | 3<br>1 | 4 |
| Total | | | 1240 |
| Less names counted twice | | | 6 |
| Net Total | | | 1234 |

# GENERAL INFORMATION

## FELLOWSHIP

The Stillman W. Robinson Fellowship in Engineering, endowed by the late Emeritus Professor of Mechanical Engineering, Stillman W. Robinson,for the encouragement of graduate research in engineering, provides five hundred dollars ($500.00) annually, and is open to graduates in Mechanical, Civil, and Electrical Engineering. Any student to whom this fellowship is awarded must devote his entire time to the work, which shall amount to at least sixteen credit hours per week, of which at least eight shall be in the line of original research or investigation. For one year's work and a satisfactory thesis, a master's degree may be given. For two year's work, and a satisfactory thesis, a doctor's degree may be given. For further informa-consult or address the Secretary of the College of Engineering.

## FEES

All fees must be paid at the opening of each semester as a condition of admission to classes. Registration is not complete until the incidental and laboratory fees are paid.

**Incidental Fee**—The fee for students who are residents of Ohio is ten dollars a semester. For non-residents, the fee is fifteen dollars a semester. Students must reside in Ohio one year before they are eligible under the resident fee. Children of non-resident Alumni pay the same fee as residents of Ohio.

Former students, who do not pay this fee until third day of the first semester and the second day of the second semester, must pay one dollar additional. For each day of delay thereafter, fifty cents is added.

**Laboratory Fees**—A fee of two dollars a semester is charged for all laboratory courses using gas, water, electrical current or steam. For all other courses which are not purely lecture courses, a laboratory fee of one dollar is charged. Students are required to pay for all materials consumed in laboratory work. To meet the cost of these materials, a deposit for each course requiring such supplies is made at the Bursar's office before the work is begun. In Chemistry the deposit is ten dollars. In other courses it varies with the amount of materials used. All laboratory supplies are sold at the General Store Room, Chemistry Hall, to students at about first cost to the University, and charged against the deposits. Any unused part of the deposits is refunded at the end of the semester.

## OTHER EXPENSES

**Locker Fee**—The gymnasium is free to all students, but those desiring to use a locker are charged a fee of two dollars a semester, which includes the rental of towels.

**Cadet Uniform**—The uniform with which the members of the regiment are required to provide themselves costs (without overcoat) about twelve dollars. It is quiet in pattern and may be worn in place of civilian dress.

New students are advised against buying second hand uniforms unless they have been previously inspected and approved by the Commandant. Inspection has shown in many cases that second hand uniforms were unfit to wear and certainly not worth the price asked for them. All such uniforms are subject to rejection by the Commandant. Students should not arrange for uniforms until so directed by the military authorities.

**Changes in Subjects or Schedule**—After the first five days of each semester changes in subjects or schedule, if made at the request of the student, shall be made only upon the payment of a fee of $1.00 for each change.

**Graduation Fee**—A fee of five dollars, to cover expense of graduation and diploma, is required of each person receiving one of the ordinary degrees from the University, and this fee must be paid before the last Friday preceding Commencement. A like fee of ten dollars is charged each person receiving one of the higher graduate degrees.

**Rooms and Board**—Furnished rooms accommodating two students, can be rented at one dollar to one dollar and a half per week for each student. Board at the restaurants and boarding clubs near the University costs from three dollars to three dollars and fifty cents per week. The Ohio Union Commons offers board to men at reasonable rates. Board, with furnished rooms, can be obtained in private families at rates varying from five to six dollars per week.

**The Ohio Union**—A fee of one dollar a semester is paid by all male students at registration. This entitles the student to all privileges of the Union, consistent with the Constitution and House Rules governing it.

**Text Books**—Students should not purchase text-books until they are advised by the instructors of their respective classes.

## EXPENSES PER YEAR

One of the most perplexing questions that confronts a prospective student is what the course is going to cost him a year.

In order to furnish information, we have listed below an estimate of the average payments required by the University for the freshman year of the various courses in the College of Engineering, and have estimated the cost for room and boarding at a safe price. These two items are sometimes reduced slightly where two students occupy the same room and where boarding clubs are economically managed. Fees to the University are paid one-half at the beginning of each semester.

| | |
|---|---|
| Incidentals | $ 20.00 |
| Ohio Union | 2.00 |
| Gymnasium Locker | 4.00 |
| Laboratory Fees | 6.00 |
| Deposits to cover laboratory materials and breakage | 20.00 |
| Drawing instruments and supplies | 20.00 |
| Uniform | 12.00 |
| Books | 15.00 |
| Board—36 weeks at $3.50 per week | 126.00 |
| Room rent, at $8.00 per month | 72.00 |
| General Expenses | 75.00 |
| | $372.00 |

The item of general expenses is always subject to the personal habits of the individual, and varies according to the degree of economy exercised.

**Note.**—In order to meet all the necessary expenses of registration, books uniform and other expenditures incident to securing a room and board, a student should come prepared to expend from $65.00 to $75.00 during the first ten days of a semester. After that period his board and room rent will constitute the major part of his expenses.

The element of economy on the part of the student enters somewhat into the cost of pursuing laboratory courses. For this reason it is impossible to fix accurately the costs for a semester or a year. In pursuing the courses of the College of Engineering, it is not likely that a student could get through a year's work with an expenditure in fees and deposits of less than twenty-five dollars, ($25.00) nor is it likely that the amount would ever exceed fifty dollars, ($50.00) excep- in cases of fines being assessed for gross carelessness or needless destruction of property.

## SELF SUPPORT

There is a considerable amount of work upon the farm and in the shops and laboratories of the University which may be assigned to students on application. Preference is given to those studying Agriculture or one of the Engineering courses. *The University cannot promise work to all applicants.* Many students find work in private families, in offices, and in various occupations, by means of which they defray at least a portion of their expenses. A person of ability and energy, who is master of a trade or who can do good work of any kind, can generally find remunerative employment. It has seldom been found that any student of ordinary energy and industry was obliged to leave the University because of lack of money for necessary expenses, after having been sixty days on the ground—or long enough to inform himself as to the opportunities for securing employment. As an accommodation, the Executive office coöperates as far as possible in this matter. The Y. M. C. A. offers its services in helping young men to secure employment. Very much depends, however, on the individual's power of initiative. Students should not come to the University expecting others to find places for them. They should report to the executive office from time to time as to their needs and their work. This will enable the authorities to be more helpful than otherwise would be possible.

A student devoting much of his time to earning his way will be unable to carry successfully the full amount of collegiate work. Such students should apply for the privilege of carrying reduced work. This, of course, means that the time required to obtain a degree will be extended to five or more years, according to the amount of work successfully carried each year.

Self-support does not excuse students from cadet service. Prospective students are advised to make note of this fact before deciding to enter the University. Special students, so-called, are also required to take the cadet service.

**Consultation.** For consultation in regard to their status as members of the College of Engineering, or for the filing of petitions, changes of the course, of class cards, adjustment of schedules and similar needs, students will apply to the Secretary, Mines Building, Room 131, from 10 to 11 a. m.

## Y. M. C. A.

The Young Men's Christian Association has come to occupy a prominent place in university life. It has a membership of about six hundred men, and is affiliated with the World's Student Christian Federation.

Religious meetings are held for men on Wednesday evening; there are also frequent meetings for the promotion of social intercourse and good fellowship. Courses in systematic Bible study and in modern missions are offered. A most helpful feature of the work is that in the interest of new students at the opening of the school year. Desirable rooms and boarding places are found and listed for reference at the Association Office. Representatives of the Association meet the trains, assist students in finding satisfactory locations, and endeavor in every way to make them feel at home. The Employment Bureau helps to find work.

A copy of the Students' Handbook, giving information about Columbus, the University, and the various college organizations and activities, will be sent free to prospective students. For this hand book or for further information, address the General Secretary of Y. M. C. A., University Campus, Columbus, Ohio.

The Ohio State University Bulletin is issued at least twenty times during the year; monthly in July, August, September and June, and biweekly in October, November, December, January, February, March, April and May.

Oh230

The Ohio State University Bulletin

VOLUME XVIII JANUARY, 1914 NUMBER 17

# COLLEGE OF ENGINEERING

## 1914-1915

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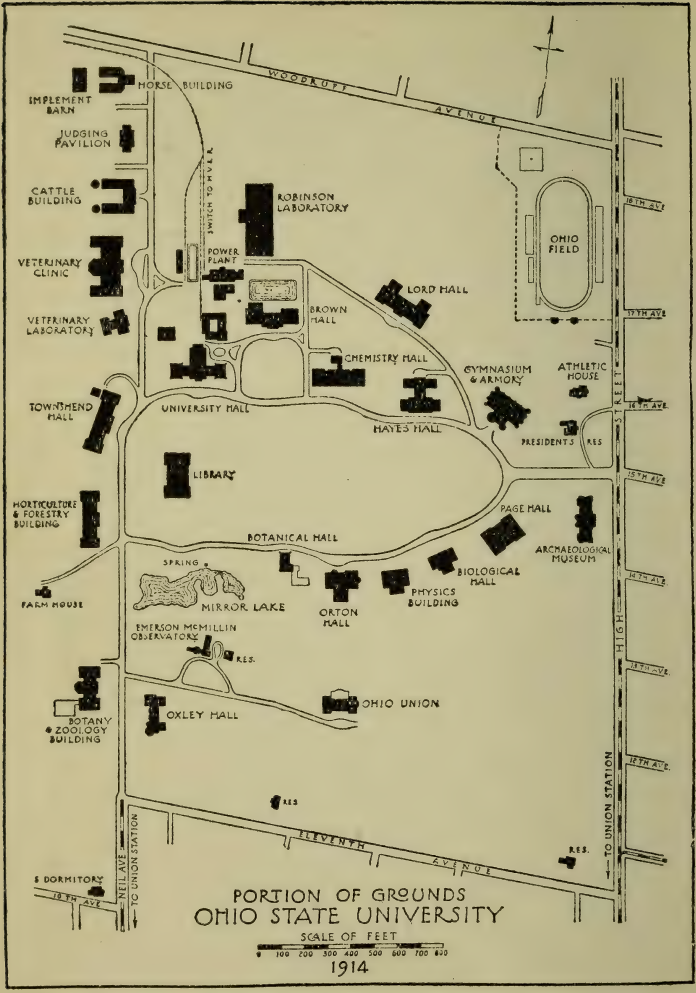

PORTION OF GROUNDS
OHIO STATE UNIVERSITY

SCALE OF FEET

1914

## THE OHIO STATE UNIVERSITY

The Ohio State University, located in Columbus, is a part of the public educational facilities maintained by the State. It comprises seven colleges and a graduate school:

The College of Agriculture,
The College of Arts, Philosophy, and Science,
The College of Education,
The College of Engineering,
The College of Law,
The College of Pharmacy,
The College of Veterinary Medicine,
The Graduate School.

This bulletin of announcements is devoted exclusively to the work of the College of Engineering, offered during the academic year beginning September, 1914.

[Note—The University publishes a bulletin descriptive of each College. Copies may be obtained by addressing W. E. Mann, University Editor, Columbus, Ohio, and stating the College in which the writer is interested.]

# UNIVERSITY CALENDAR

## 1914

Entrance examinations, Tuesday to Saturday, June 9 to 13, 8 a. m.

Summer Session, June 22 to August 14.

Entrance examinations, Tuesday to Saturday, September 8 to 12, 8 a. m.

First semester begins—Registration Day—Tuesday, September 15.

President's Annual Address, Friday, September 18, 11 a. m.

Latest date of admission to candidacy for a degree at the Commencement of June, 1915, Thursday, October 1.

Date for mid-semester reports to the Deans concerning delinquent students, Wednesday, November 18.

Thanksgiving recess begins November 25, 6 p. m., and ends December 1, 8 a. m.

Christmas recess begins Saturday, December 19, 12 m.

## 1915

Christmas recess ends Tuesday, January 5, 8 a. m.

Final examinations Thursday, January 28, to Thursday, February 4.

First semester ends Thursday, February 4, 6 p. m.

Second semester begins—Registration Day—Tuesday, February 9.

Washington's Birthday, Monday, February 22.

Mid-semester reports to the Deans, Saturday, March 20.

Easter recess, Saturday, March 27, 12 m., to Tuesday, April 6, 8 a. m.

Western inspection trip, April 25 to May 2.

Competitive Drill—Cadet Regiment—Saturday, May 22.

Memorial Day, Sunday, May 30.

Final examinations, Friday, June 4, to Thursday, June 10.

Entrance examinations, Tuesday, June 8, to Saturday, June 12, 8 a. m.

Commencement, Wednesday, June 16.

# THE COLLEGE OF ENGINEERING

The purpose of the College of Engineering is to instruct students thoroughly in the fundamental sciences and arts upon which all engineering rests, and to impart such special and technical knowledge of the various branches of engineering as will enable students to enter them and maintain themselves while gaining their professional experience. In addition, it is believed that the severe mental discipline of the various courses of instruction makes the engineering curriculum fully the equal of any other in general educational value.

## COURSES LEADING TO BACHELOR DEGREES

This college offers instruction in seven important fields of engineering work. Covering these the following four-year courses of study are offered:

1. Architecture, leading to the degree of Bachelor of Architecture, (B. Arch.)
2. Ceramic Engineering, leading to the degree of Bachelor of Ceramic Engineering, (B. Cr. E.)
3. Chemical Engineering, leading to the degree of Bachelor of Chemical Engineering, (B. Ch. E.)
4. Civil Engineering, leading to the degree of Bachelor of Civil Engineering, (B. C. E.)
5. Electrical Engineering, leading to the degree of Bachelor of Electrical Engineering, (B. E. E.)
6. Mechanical Engineering, leading to the degree of Bachelor of Mechanical Engineering, (B. M. E.)
7. Mine Engineering, leading to the degree of Bachelor of Engineering inMining, (B. E. M.)

C

These degrees will be conferred regularly for the first time in 1915. Students graduating before that time will receive degrees as published in prior issues of this bulletin, unless by special agreement between the faculty and students concerned.

## FIVE YEAR COURSE

For the benefit of those who are unable to carry the full schedule, on account of outside work for self-support, impaired health, or any other valid reason, any of the regular courses can be rearranged to cover five instead of four years.

## COMBINATION COURSES

It is also possible to arrange combination courses leading to two degrees (see page 32) in five or more years.

## GRADUATE COURSES

Advanced courses in various engineering subjects are offered, to those who wish to pursue them, by the Departments of the College of Engineering. If such courses are pursued with the expectation of receiving credit upon them to apply towards any higher degree, the student must register in the Graduate School, under whose jurisdiction all work for the higher degrees is conducted. For further information, consult the bulletin of the Graduate School of the University or confer with the Dean or Secretary.

## SHORT COURSES

The following two-year or short courses, do not lead to a degree, but students completing them are furnished a formal certificate stating the work they have accomplished:

1. Clay-working.
2. Industrial Arts.
3. Mining.

A two-week course in Highway Engineering similar to the one described on page 37 will probably be given in 1915.

# CORPS OF INSTRUCTION

## EXECUTIVE

WILLIAM OXLEY THOMPSON, D. D., LL. D., President of the University.

CARL E. STEEB, B. Ph., Secretary of the Board of Trustees.

EDWARD ORTON, Jr., E. M., Dean of the College of Engineering.

EDWIN F. CODDINGTON, C. E., Ph. D., Secretary of the College of Engineering.

EDITH D. COCKINS, B. A., Registrar.

OLIVE BRANCH JONES, B. A., Librarian.

## ARCHITECTURE

JOSEPH NELSON BRADFORD, M. E., Professor.

CHARLES ST. JOHN CHUBB, JR., C. E., (Arch.), Professor.

FRANK HAGER HASKETT, Instructor.

WILBERT CATHMORE RONAN, C. E., (Arch.), B. S., (Arch.), Instructor.

## ASTRONOMY

HENRY CURWEN LORD, B. Sc., Professor.

EDMUND SEWELL MANSON, Jr. S. M., Associate Professor.

## CERAMIC ENGINEERING

EDWARD ORTON, Jr., E. M., Professor.

ARTHUR S. WATTS, Professor.

CARL B. HARROP, E. M., Assistant Professor.

## CHEMISTRY

WILLIAM MCPHERSON, D. Sc., Ph. D., Professor.

SIDNEY AUGUSTUS NORTON, Ph. D., LL. D., Emeritus Professor.

WILLIAM EDWARDS HENDERSON, Ph. D., Professor.

CHARLES WILLIAM FOULK, B. A., Professor.

WILLIAM LLOYD EVANS, Ph. D., Professor.

JAMES RENWICK WITHROW, Ph. D., Professor.

CHARLES FORD LONG, M. A., Assistant Professor.

CECIL ERNEST BOORD, Ph. D., Instructor.

JESSE ERWIN DAY, B. A., Assistant.

ELMER E. HOCKETT, B. A., Assistant.

HOMER DENISON HOLLER, B. A., Assistant.

Robert C. Hammill, B. A., Assistant.
John Bernard Dickson, A. B., Assistant.
Edwin Schmidt, A. B., Assistant.
And Fourteen Fellows.

## CIVIL ENGINEERING

Christopher Elias Sherman, C. E., Professor.
Frank Harvey Eno, B. S., C. E., Professor.
Clyde Tucker Morris, C. E., Professor.
Roy Karl Schlafly, C. E., Assistant Professor.
William Stanley Hindman, C. E., Assistant Professor.
Roscoe C. Sloane, C. E., Instructor.
George F. Schlesinger, C. E., Instructor.
Earl Warner McCoy, Assistant.

## ELECTRICAL ENGINEERING

Francis Cary Caldwell, B. A., M. E. in E. E., Professor.
Alan Estis Flowers, M. E. in E. E., M. S., Professor.
John Ernest Shepardson, B. S., Instructor.
Roy Atkinson Brown, M. E. in E. E., Instructor.
Robert Mickey Moody, M. E. in E. E., Assistant.

## ENGINEERING DRAWING

Thomas Ewing French, M. E., Professor.
Robert Meiklejohn, M. E., Assistant Professor.
Owen Etsel Williams, Instructor.
Arthur C. Harper, M. E., Instructor.
William James Norris, Instructor.
Cree Sheets, C. E., (Arch.), Instructor.
Frederick W. Ives, B. S. in M. E., Instructor.
William D. Turnbull, C. E., Instructor.
Edward J. Gilbert, M. E., Instructor.
Theodore H. Pyle, Student Assistant.

## ENGLISH

Joseph Villiers Denney, M. A., Professor.
George Harley McKnight, Ph. D., Professor,
William Lucius Graves, M. .A., Professor.
Carson Samuel Duncan, Ph. D., Assistant Professor.
Louis Albion Cooper, B. A., Assistant Professor.

Edwin Long Beck, M. A., Assistant Professor.
Victor A. Ketcham, A. B., LL. B., Assistant Professor.
J. Forest Craig, A. B., Instructor.
And Fourteen Fellows.

## GEOLOGY

Charles Smith Prosser, D. Sc., Ph. D., Professor.
John Adams Bownocker, D. Sc., Professor.
Thomas McDougal Hills, B. Ph., Assistant Professor.
Walter A. Verwiebe, A. B., Instructor.
Clara Gould Mark, M. A., Instructor.
And One Fellow.

## GERMAN

M. Blakemore Evans, Ph. D., Professor.
Berthold August Eisenlohr, M. A., Professor.
May Thomas, Ph. D., Assistant Professor.
Sarah Tracy Barrows, M. L., Assistant Professor.
Ludwig Lewisohn, M. A., Assistant Professor.
Robert Oscar Busey, M. A., Assistant Professor.
Heinrich Carl Keidel, Ph. D., Instructor.
Theodore Franklin Kotz, M. A., Instructor.
Ross Brook Wildermuth, A. B., Assistant.

## INDUSTRIAL ARTS

Frank Edwin Sanborn, S. B., Professor.
William Abner Knight, M. E., Associate Professor.
Clement Medary Beem, Instructor.
Allando A. Case, Instructor.
Jacob Allen Foust, Instructor.
Ulysses Wallace Denman, Assistant.
John Joseph Breckur, Assistant.
Robert Ernest Smith, Assistant.
Perry Lisbon Wright, Assistant.
Harold Wright, Apprentice.

## MATHEMATICS

Rosser Daniel Bohannan, B. Sc., C. E., E. M., Professor.
George Washington McCoard, M. A., Professor.
Karl Dale Swartzel, M. Sc., Professor.
Harry Waldo Kuhn, Ph. D., Professor.

Samuel Eugene Rasor, S. M., Professor.
Charles Lincoln Arnold, M. Sc., Associate Professor.
John Bowker Preston, M. A., Assistant Professor.
Grace Marie Bareis, B. A., Assistant Professor.
Charles Clement Morris, M. A., Assistant Professor.
Carl Joseph West, M. A., Assistant Professor.
Hortense Rickard, B. A., Assistant

## MECHANCIAL ENGINEERING

William Thomas Magruder, M. E., Professor.
Franklin Wales Marquis, B. S. in M. E., Professor.
Horace Judd, M. E., M. Sc., Associate Professor.
Aubrey Ingerson Brown, Instructor.
Robert Hill Neilan, M. E., Assistant.
Fred G. Tarbox, Student Assistant.

## MECHANICS

James Ellsworth Boyd, M. S., Professor.
Edwin F. Coddington, C. E., Ph. D., Professor.
Landis Hess Brubaker. Student Assistant.

## METALLURGY

Edward Elsworth Somermeier, G. Ph., Professor.
Dana James Demorest, B. Sc. (Chem.), Professor.

## MINERALOGY

William John McCaughey, Ph. D., Assistant Professor.

## MILITARY SCIENCE AND TACTICS

George L. Converse, U. S. A., (Ret.), Professor.

## MINE ENGINEERING

Frank Arnold Ray, E. M., Professor.
Wells Hammond Minor, E. M., Assistant Professor.
Ira Callender, Student Assistant.
Warner Stafford, Student Assistant.
Herbert George Coon, Student Assistant.

## PHYSICAL EDUCATION

H. Shindle Wingert, M. D., Professor.
George H. Bartholomew, Instructor.
Henry C. Ohlson, Instructor.
Alice Littlejohn Goetz, M. D., Associate Professor.

### PHYSICS

ALFRED DODGE COLE, A. M., Professor.
ROBERT FRANCIS EARHART, Ph. D., Professor.
FREDERIC COLUMBUS BLAKE, Ph. D., Professor.
SAMUEL JACKSON BARNETT, Ph. D., Professor.
CHARLES SHEARD, A. M., Assistant Professor.
ALPHEUS WILSON SMITH, Ph. D., Assistant Professor.
HERMAN GUSTAVUS HEIL, Ph. B., Instructor.
ALVA WELLINGTON SMITH, B. A., Assistant.
AND THREE FELLOWS.

### ROMANCE LANGUAGES AND LITERATURES

BENJAMIN LESTER BOWEN, Ph. D., Professor.
CHARLES A. BRUCE, B. A., Professor.
EDGAR SHUGERT INGRAHAM, Ph. D., Professor.
THEODORE ELY HAMILTON, Ph. D., Assistant Professor.
GEORGE SCOTT CHAPIN, M. A., Assistant Professor.
OTTO FERDINAND BOND, B. A., Instructor.
JAY KARL DITCHY, M. A., Instructor.
HOWARD FLOYD DUNHAM, B. A., Instructor.
ALEXANDER PARK MOORE, B. A., Instructor.

## ADMISSION

Applicants for admission must be at least seventeen years of age. The College is open on equal terms to both sexes.

### THE ENTRANCE BOARD

The admission of students to the University is in charge of the Entrance Board, which determines the credit that shall be issued on all entrance examinations and certificates, and furnishes all desired information to applicants. Correspondence relating to admission should be addressed to the Secretary of the Entrance Board, Ohio State University, Columbus, Ohio.

### ADMISSION TO COURSES LEADING TO DEGREES

There are two modes of admission to courses leading to degrees: (a) by examinations; (b) by certificate.

## ADMISSION BY EXAMINATION

The Entrance Board will conduct entrance examinations June 9 to 13 and September 8 to 12, 1914. Part of the examinations may be taken in June and the remainder in September. All applicants for admission who do not possess certificates covering entrance requirements must take examinations for admission.

Schedule of Examinations. The hours for examinations are 8 A. M. and 1 P. M. Students intending to take any of examinations scheduled in any given half day must appear within one hour of the time set for the examination. Students applying for examination will first go to the office of the Entrance Board, 100 University Hall, for registration.

| | | |
|---|---|---|
| Tuesday | A. M. | History: Ancient and Medieval (to 814 A. D.), Medieval and Modern (after 814 A. D.), English. |
| " | P. M. | English Composition and Rhetoric, English Classics, Chemistry. |
| Wednesday | A. M. | Algebra, Physical Geography, Greek. |
| " | P. M. | Plane Geometry, German, Spanish. |
| Thursday | A. M. | Civil Goverment, Solid Geometry, Zoology. |
| " | P. M. | Beginning Latin and Cæsar, Elements of Agriculture, Trigonometry, Commercial Geography. |
| Friday | A. M. | Physics, Physiology, Botany. |
| " | P. M. | American History, French, English Literature. |
| Saturday | A. M. | Vergil, Cicero, Domestic Science. |

## TOPICS FOR EXAMINATION

| | |
|---|---|
| English.................................<br>(Foreign students may substitute their native language for the English requirement.) | 1, 2, 3, or 4 units |
| American History or American History and Civil Government ................................ | 1 unit |
| Ancient History (Greek and Roman) and Medieval History to 814 A. D.......................... | 1 unit |
| Medieval and Modern History (from 814 A. D. to the present)....................................<br>(For the present General History may be counted as a unit, but not in addition to Ancient or Medieval and Modern History.) | 1 unit |

| | |
|---|---|
| English History | ½ or 1 unit |
| Algebra (through quadratics) | 1 unit |
| Algebra (beyond quadratics) | ½ unit |
| Geometry (plane) | 1 unit |
| Geometry (solid) | ½ unit |
| Trigonometry | ½ unit |
| Latin | 1, 2, 3, or 4 units |
| Greek | 1, 2, or 3 units |
| German | 1, 2, 3, or 4 units |
| French | 1, 2, 3, or 4 units |
| Spanish | 1, 2, 3, or 4 units |
| Physics | 1 unit |
| Chemistry | 1 unit |
| Physical Geography | ½ or 1 unit |
| Zoölogy | ½ or 1 unit |
| Botany | ½ or 1 unit |
| Physiology | ½ unit |
| Geology | ½ or 1 unit |
| Astronomy | ½ or 1 unit |
| Agriculture | ½ or 1 unit |
| *Free-hand drawing<br>Manual Training<br>Domestic Science<br>Commercial Subjects | The Entrance Board may after investigating each claim, grant a total credit of not to exceed......... 4 units |

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*Students expecting to enter the College of Engineering are advised to take free-hand drawing in high school.

A special bulletin of Entrance Information will be mailed on request. Address The University Editor.

## ADMISSION BY CERTIFICATE

Applicants may be admitted without examination on presentation of properly endorsed certificates from such secondary schools as have been accredited or recognized by the University, or from approved normal schools, or from the State Board of School Examiners under the following provisions:

(a) If from secondary schools, the certificate must show that the applicant is a graduate in good standing of the school issuing it; and also must state in detail the studies pursued, the text-books used, the amount of work done in each study, the amount of time devoted to it, and the fact that the applicant has passed in the work.

(b) Any entrance requirement not covered by a certificate must be met by examination.

Blank certificates may be obtained by addressing the Secretary of the Entrance Board. Certificates should be filled out by the proper official and returned to the University as early as possible after the close of schools in June.

## REQUIREMENTS BY UNITS

To obtain full standing in the College of Engineering, applicants under twenty-one years of age must have credit by examination or certificate for fiteen units. A unit is the equivalent of a course of study covering a school year, during which one hundred and twenty clock-hours are devoted to class-room work on the study. Two hours in the laboratory are equivalent to one hour in the class-room.

Of these fifteen units, not less than three shall be English; three, mathematics (including solid geometry); one, physics; four, languages (other than English); and the balance shall be elective, and may include any subject given by any school accredited or recognized by the University. A study listed as a half unit will be counted merely as such even if the course has extended for more than a half year. A study listed as one-half or one unit will be given either rating, depending upon the length of the course. On a study listed as one unit, no credit will be given for less than a year's work.

In foreign languages, six units are required in the preparatory school and college combined. These six units may be done wholly in the preparatory school, or partly in the preparatory school and partly in college, in which case at least two units must be done in college, or under some circumstances the entire six units may be done in college. They may be taken in any one of the three modern languages or any combination of the five ancient and modern languages, listed above, provided that not less than two units of any single language be offered.

In case of schools in which Manual Training is especially recommended, two units of Foreign Language may be replaced by two units of Manual Training or Mechanical Drawing.

No student under twenty-one years of age will be admitted to college if he is conditioned in more than two of the fifteen units. An applicant twenty-one years of age or over may be admitted with a total deficiency of four units. Of these four units, all may be in foreign language, but not more than two units may be in subjects other than foreign language.

Students over twenty-one years of age may also be admitted as special students in accordance with the provisions stated under "Admission to Special Studies."

The extent and character of the work required in each subject mentioned above is explained in a special bulletin entitled "Definitions of Entrance Units," which will be sent by the University Editor to any address, upon request.

## REMOVAL OF ENTRANCE CONDITIONS

The removal of entrance conditions is administered by the Entrance Board. Conditions may be removed (1) by examination, or (2) by the substitution of excess work in other approved subjects, or (3) by the substitution of other equivalent work to be done at the University. All entrance conditions must be removed within two years after admission. If, at the end of the first year, a student still has entrance conditions outstanding, the Secretary of the College will assign such college courses as may be deemed a fair equivalent for the work in which the student has entrance conditions. A condition in physics must be removed before entering on the work of the second year. (See also statement on page 14 on foreign languages.)

## ADMISSION WITH ADVANCED STANDING

Applicants who have completed at least one year's work of collegiate rank in an approved college, and who bring official and explicit certificates describing their course of study and scholarship, and letters of honorable dismissal, will be admitted in accordance with either of two plans:

(1) The entrance units on which the candidate was admitted to the approved college will be accepted at their face value; deficiencies will be made up from the college credits presented, and advance credit will be given for any remaining satisfactory work; or

(2) One year's work will be accepted in lieu of entrance unit and the candidate will be admitted without examination and without conditions, but without any advanced standing on the year's work.

Applicants who have completed less than one year's work in an approved college must satisfy the entrance requirements in the usual way, and will then be given credit for any satisfactory work for which they can offer certificates.

## ADMISSION TO SPECIAL STUDIES

Students who desire to pursue special lines of work in the University, and do not intend to become candidates for degrees, will be admitted on the following conditions:

1. If the applicant can satisfy the entrance requirements, he must send to the Entrance Board for reference to the Executive Committee of the College of Engineering a complete statement of the course which he wishes to take, together with his reasons for desiring this course and a detailed statement of his practical experience in engineering.

2. If he can not satisfy the entrance requirements, but is at least twenty-one years of age, he *may* be admitted by the joint action of the Entrance Board and the Executive Committee of the College of Engineering, provided he passes the entrance examination in algebra and plane geometry. Such a student must send a full statement of the course he wishes to pursue, his practical experience in engineering, and certificates from his employers giving the nature and duration of his experience.

3. Permission to enter as special undergraduates will be refused to all who fail to give satisfactory evidence of definiteness of purpose and will be withdrawn whenever the conditions on which it was granted cease to exist.

## ADMISSION TO THE SHORT COURSES

Applicants must be at least seventeen years of age and, unless they are over twenty-one years of age, must pass examinations in arithmetic and geography and must be able to write a business letter or a short theme, correct in grammar and orthography; or they must present satisfactory certificates showing that they have succesfully pursued these subjects elsewhere. In addition, each applicant under twenty-one years of age must present a letter or certificate showing that he has at least two years' consecutive practical experience in some industry related to the course which he wishes to pursue, and this certificate must be satisfactory to the Executive Committee of the College of Engineering.

Applicants over twenty-one years of age are admitted without examination, but must present a letter or certificate covering practical experience, as provided in the case of those under twenty-one years of age.

# COURSES OF STUDY

## OUTLINE OF THE FIRST YEAR'S WORK OF ALL FOUR-YEAR COURSES

In order to permit all engineering students to have a year in which to ascertain their tastes more fully and find out definitely what courses they desire to pursue, the first year of all engineering courses is made uniform. While students are asked to indicate their choice of courses on entering the college, they can change at the end of the first year without any inconvenience.

NOTE—The figure in parenthesis following the name of each study indicates the number of the study in its department; the other figure indicates the number of credit hours.

| First Semester | | | Second Semester | | |
|---|---|---|---|---|---|
| Mathematics | (131) | 5. | Mathematics | (132) | 5. |
| College Algebra and Trig. | | | Trig. and Analytics. | | |
| Chemistry | (105 or 109)* | 4. | Chemistry | (106 or 110)* | 4. |
| General Chemistry. | | | General Chemistry and Qualitative Analysis. | | |
| Modern Language | | 4. | Modern Language | | 4. |
| French, Ger., or Span. | | | French, Ger., or Span. | | |
| English | (101) | 2. | English | (104) | 2. |
| Paragraph Writing. | | | Paragraph Writing. | | |
| Engineering Drawing | (101) | 2. | Engineering Drawing | (102) | 3. |
| Elementary Mechanical. | | | Lettering and Projections. | | |
| Military Drill | | 1. | Military Drill | | 1. |
| Gymnasium | | 1. | Gymnasium | | 1. |

*Students presenting Chemistry as an entrance subject will take Chemistry 109 and 110. Students with no entrance credits in Chemistry will take Chemistry 105 and 106.

## SUMMER SESSION

Shop work is required in the Summer Session in all Engineering courses except Architecture and Civil Engineering. In the courses in Electrical, Mechanical, and Mine Engineering, the shopwork courses (109) and (115) are required at the end of the first year. In the course in Chemical Engineering, the same courses are required, but may be taken at the end of the first or second year. In the course in Ceramic Engineering, the three courses (107), (109), and (115) are offered and two of these must be taken at the end of the first year.

## ARCHITECTURE

The special architectural work of the course commences in the second year with history of architecture, which affords instruction in the principles governing design in classic, medieval and renaissance work, and the proper use to be made of precedent. The history of architecture is accompanied by a course in drawing and design devoted to the "order problems." Courses involving class and drawing room work are given during this year in shades and shadows, and architectural perspective.

Throughout the third and fourth years practical designing courses are given, which include problems relating to residences, apartment houses, school buildings, public buildings, tall steel-framed office buildings, and ecclesiastical structures. Decoration, architectural composition, working drawings, and structural details are covered in separate courses during the third year, while monumental design, specifications, estimating, sanitary plumbing, and professional practise are studied in the fourth year.

Drawing, both free hand and mechanical, is very essential to the architect. Thus, in addition to the extensive practise which the student gets in his designing, a series of courses in drawing and allied subjects run through the four years.

On the structural side courses are given in trusses, cement work, masonry, steel construction, reinforced concrete, and surveying. Work in the testing of materials and in heating and ventilating is also given. A thesis, usually the complete plans and specifications for some important structure, is required before graduation.

A special bulletin describing more fully the work of this department will be mailed on request. Address the University Editor.

## COURSE IN ARCHITECTURE

FOR FIRST YEAR, SEE PAGE 17

### SECOND YEAR

| FIRST SEMESTER | | | SECOND SEMESTER | | |
|---|---|---|---|---|---|
| Mathematics<br>Calculus. | (141) | 5. | Mathematics<br>Calculus. | (142) | 5. |
| Engineering Drawing<br>Charcoal from Ornament. | (115) | 2. | Engineering Drawing<br>Pen Drawing. | (116) | 2. |
| Architecture<br>History of Architecture. | (101) | 3. | Architecture<br>History of Architecture. | (102) | 3. |
| Architecture<br>Order Problems. | (103) | 2. | Architecture<br>Order Problems. | (104) | 5. |
| Engineering Drawing<br>Descriptive Geometry. | (107) | 3. | Architecture<br>Shades, Shadows, and Perspective. | (124) | 3. |
| Physics<br>General Physics. | (111) | 3. | | | |
| Military Drill | | 1. | Military Drill | | 1. |

SUMMER COURSE—Architecture (120), Architectural Practise, or an Architectural Problem. 4 credit hours.

### THIRD YEAR

| | | | | | |
|---|---|---|---|---|---|
| Mechanics<br>Statics and Str. of Materials. | (101) | 5. | Mechanics<br>Strength of Materials. | (104) | 2. |
| Engineering Drawing<br>Water Color. | (117) | 3. | Engineering Drawing<br>Charcoal from Antique. | (118) | 3. |
| Architecture<br>Design. | (107) | 5. | Architecture<br>Design. | (108) | 4. |
| Architecture<br>Decoration, etc. | (109) | 3. | Architecture<br>Working Drawings | (110) | 4. |
| Architecture<br>Arch. Composition. | (115) | 2. | Architecture<br>Photography. | (112) | 2. |
| | | | Civil Engineering<br>Trusses. | (124) | 3. |

SUMMER COURSE—Architecture (121), Architectural Practise, or an Architectural Problem. 4 credit hours.

### FOURTH YEAR

| | | | | | |
|---|---|---|---|---|---|
| Architecture<br>Design. | (115) | 6. | Architecture<br>Design. | (114) | 3. |
| Architecture<br>Plumbing. | (117) | 1. | Architecture<br>Professional Practise. | (116) | 4. |
| Architecture<br>Masonry. | (119) | 2. | Civil Engineering<br>Surveying. | (128) | 2. |
| Civil Engineering<br>Tall Buildings. | (125) | 3. | Civil Engineering<br>Cement and Concrete. | (118) | 3. |
| Mechanical Eng.<br>Materials of Const. | (123) | 2. | Architecture<br>Thesis. | (118) | 5. |
| Mechanical Eng.<br>Heating and Ventilating. | (121) | 2. | | | |
| Engineering Drawing<br>Clay Modeling. | (119) | 2. | | | |

## CERAMIC ENGINEERING

Ceramic Engineering is the application of chemistry and engineering to a well defined group of non-metallic mineral industries; viz., clayworking, glass manufacture, and cement manufacture. These industries all manufacture silicate products and employ the same raw material to a large extent, and thus constitute a natural division of chemical technology.

The ceramic engineer should be something of a geologist and mining engineer in order to discover and work his raw material. He should be a mechanical engineer to prepare these materials and manufacture them into the required shape, and he must be a chemist to understand what takes place in kilns and furnaces. His course, while founded upon chemical technology, must still be broad and varied and include a liberal amount of general engineering.

The technical work in ceramic engineering begins in the second year with a laboratory course running through the year, dealing with the chemical analysis of the various materials used in ceramic industries. This is accompanied by a course in ceramic calculations, and by a course of lectures through the year, which cover the winning of the materials, their preparation and manufacture. In third year this course is continued on the drying, burning, and decoration of the ceramic products. In the fourth year, laboratory courses on the manufacture of ceramic bodies, the production of glazes, and the production of enamels and colors continue the ceramic training. However, a course on cement manufacture may be elected in place of the course on enamels and colors. In this year there is also a course on the drawing and design of ceramic structures. The ceramic subjects constitute about 35 per cent of the total work required for the degree.

## COURSE IN CERAMIC ENGINEERING

FOR FIRST YEAR, SEE PAGE 17

### SECOND YEAR

| First Semester | | | Second Semester | | |
|---|---|---|---|---|---|
| Mathematics<br>Calculus. | (141) | 5. | Mathematics<br>Calculus. | (142) | 5. |
| Physics<br>Mechanics and Heat. | (111) | 3. | Physics<br>Elec. Light and Sound. | (112) | 3. |
| Engineering Drawing<br>Descriptive Geometry. | (103) | 3. | Engineering Drawing<br>Machine Sketching. | (104) | 3. |
| Ceramic Engineering<br>Ceramic Chemistry. | (101) | 4. | Ceramic Engineering<br>Laboratory. | (102) | 4. |
| Ceramic Engineering<br>Clays. | (141) | 3. | Ceramic Engineering<br>Clay Wares. | (142) | 3. |
| Military Drill | | 1. | Military Drill | | 1. |

### THIRD YEAR

| | | | | | |
|---|---|---|---|---|---|
| Mechanics<br>Statics and Str. Materials. | (101) | 5. | Mechanics<br>Strength of Materials. | (104) | 2 |
| Chemistry<br>Physical Chemistry. | (157) | 3. | Chemistry<br>Physical Chemistry. | (158) | 3. |
| Mine Engineering<br>Mine Surveying. | (103) | 4. | Civil Eng.<br>Trusses. | (124) | 3. |
| Ceramic Engineering<br>Drying and Burning | (143) | 3. | Ceramic Engineering<br>Decoration of Clay Wares. | (144) | 3. |
| Ceramic Engineering<br>Calculations. | (105) | 2. | Ceramic Engineering<br>Phys. Chem. Measurements. | (108) | 3. |
| Mine Engineering<br>Mine Trip. | (109) | 1. | Mech. Engineering<br>Mechanism and Design. | (110) | 3. |

### FOURTH YEAR

| | | | | | |
|---|---|---|---|---|---|
| Ceramic Engineering<br>Laboratory. | (111) | 5. | *Ceramic Engineering<br>Laboratory. | (112) | 5. |
| Ceramic Engineering<br>Drawing. | (113) | 5. | Ceramic Engineering<br>Drawing. | (114) | 5. |
| Geology<br>General Geology. | (165) | 3. | *Ceramic Engineering<br>Cement Lectures. | (118) | 5. |
| Metallurgy<br>Gen. Metallurgy. | (109) | 4. | Civil Engineering<br>Cement and Concrete. | (118) | 3. |
| | | | Ceramic Engineering<br>Thesis. | (116) | 4. |

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*Alternative courses. One must be taken.

## CHEMICAL ENGINEERING

The course in Chemical Engineering has been prepared to meet the growing demands for trained men in the numerous industries which employ chemical processes prominently in their work, and which are not included in the fields of metallurgy and ceramics. Among such may be mentioned the manufacture of acids, alkalies, salts, paints, dyes, soaps, glue, starch, sugar, preservatives, antiseptics, fertilizers, and others.

This course differs from the ordinary course in Chemistry in that it is extended greatly along engineering lines. There are four full years' work in consecutive chemical courses: elementary chemistry and qualitative analysis in the first year; advanced chemistry and quantitative analysis in the second; organic chemistry in the third; and physical and industrial chemistry in the fourth. In addition, there are several auxiliary elective courses in chemistry, and further chemical applications are given in metallurgy, assaying, and mineralogy in another department.

In the engineering line, beside the usual fundamental work in mathematics, physics, mechanics, and drawing, four weeks each of carpentry and forging is given in the first summer, a course in technical drawing, dealing chiefly with chemical machinery in the third year. This leads up to a course in machine design in the fourth year. There are also courses in power plants and electrical machinery.

In addition to the elective work offered in the fourth year, four credit hours must be devoted to the preparation of a thesis. A special bulletin describing this department will be mailed upon request. Address the University Editor.

## COURSE IN CHEMICAL ENGINEERING

FOR FIRST YEAR, SEE PAGE 17

### SECOND YEAR

| First Semester | | | Second Semester | | |
|---|---|---|---|---|---|
| Mathematics<br>Calculus. | (141) | 5. | Mathematics<br>Calculus. | (142) | 5 |
| Physics<br>Gen. Physics. | (111) | 3. | Physics<br>Gen. Physics. | (112) | 3 |
| Engineering Drawing<br>Descriptive Geometry. | (103) | 3. | Engineering Drawing<br>Machine Sketching. | (104) | 3 |
| Chemistry<br>Quantitative Analysis. | (119) | 4. | Chemistry<br>Quantitative Analysis. | (120) | 4. |
| Chemistry<br>Adv. Gen. Chemistry. | (113) | 2. | Chemistry<br>Adv. Gen. Chemistry. | (114) | 2. |
| | | | Chemistry<br>Chemical Problems. | (124) | 1. |
| Military Drill | | 1. | Military Drill | | 1 |

### THIRD YEAR

| | | | | | |
|---|---|---|---|---|---|
| Mechanics<br>Statics and Str. Matr'ls. | (101) | 5. | Mechanics<br>Kinetics and Hydraulics. | (102) | 5 |
| Engineering Drawing<br>Technical Drawing. | (121) | 2. | Engineering Drawing<br>Technical Drawing. | (122) | 2 |
| Metallurgy<br>Gen. Metallurgy. | (109) | 4. | Mineralogy<br>Mineralogy and Cryst'g'phy. | (102) | 3 |
| Chemistry<br>Organic Chem., lec. | (151) | 2. | Chemistry<br>Organic Chem., lec. | (152) | 2. |
| Chemistry<br>Organic Chem., lab. | (153) | 2. | Electives<br>(See foot note.) | | 5 to 7 |
| Mechanical Eng.<br>Steam Power Plants. | (103) | 3. | | | |

### FOURTH YEAR

| | | | | | |
|---|---|---|---|---|---|
| Mechanical Eng.<br>Machine Design. | (127) | 5. | Mechanical Eng.<br>Machine Design. | (144) | 5. |
| Chemistry<br>Physical Chemistry. | (157) | 3. | Chemistry<br>Physical Chemistry. | (158) | 3. |
| Chemistry<br>Industrial Chemistry. | (177) | 2. | Chemistry<br>Industrial Chemistry. | (178) | 1. |
| Chemistry<br>Indust. Chem., lab. | (185) | 2. | Chemistry<br>Indust. Chem., lab. | (186) | 3. |
| Electrical Eng.<br>Elementary Elec. Eng. | (101) | 5. | Chemistry<br>Thesis. | (140) | 4. |
| | | | Chemistry<br>Inspection Trip. | (182 or 184) | 1. |
| | | | Elective | | 2. |

Electives in third year, second semester, must be chosen from the following courses, subject to approval of the departments concerned: Chemistry (136) 2, Chemical Literature; Chemistry (154) 2 or 3, Advanced Organic Chemistry; Chemistry (168) 3 to 5, Advanced Qualitative Analysis; Chemistry (176) 3, Sanitary Analysis; Chemistry (188) 2 or 3, Inorganic Preparations; Chemistry (192) 2, Rare Elements; (given only in odd numbered years); Metallurgy (110) 4, General Metallurgy; Metallurgy (112) 2, Calorimetry and Mine Gas Analysis.

## CIVIL ENGINEERING

Among the special fields which are usually included under the title of civil engineering are those of the design, construction, and maintenance of bridges, railroads, municipal water supplies, sewers, street paving, road building and other public and private works, irrigation projects, and river and harbor improvements. The civil engineer also superintends topographic and geodetic surveys and does many other special lines of work.

The course of instruction is designed to provide the foundation upon which all of these specialties are built.

The technical work begins in the second year with courses in land and railroad surveying, accompanied by practise in the field, and by class-room work in topographic drawing. In the third year are courses in topographic surveying, a drawing-room course in timber construction, and in stereotomy, and class-room courses in roads and streets, bridge stresses, and sanitary engineering. In the fourth year are given a lecture and laboratory course in cement testing and courses in bridge design, masonry structures, and reinforced concrete; also class-room courses in masonry construction, water supply engineering, and contracts and specifications. There is also an opportunity to select between a course in advanced bridge designing and one in railway location.

Distributed through the third and fourth years are courses in the applications of electrical machinery, least squares, astronomy, photography, water pumps and motors, testing of materials of construction, calibrations of weirs, and general geology. Most of these courses include laboratory practise. In each of the summers following the second and third years, four weeks of field practise in surveying is required, and before graduation, a thesis giving results of some original work along civil engineering lines.

## COURSE IN CIVIL ENGINEERING

FOR FIRST YEAR, SEE PAGE 17

### SECOND YEAR

| FIRST SEMESTER | | | SECOND SEMESTER | | |
|---|---|---|---|---|---|
| Mathematics<br>Calculus. | (141) | 5. | Mathematics<br>Calculus. | (142) | 5. |
| Physics<br>Gen. Physics. | (111) | 3. | Physics<br>Gen. Physics. | (112) | 3. |
| Engineering Drawing<br>Descriptive Geometry. | (105) | 3. | Engineering Drawing<br>Advanced Descriptive Geom. | (106) | 3. |
| Civil Eng.<br>Land Surveying and Field Practise. | (101 and 101a) | 4 & 1. | Civil Eng.<br>R. R. Surveying and Field Practise. | (102 and 102a) | 3 & 1. |
| Civil Engineering<br>Topographic Drawing. | (103) | 2. | Geology<br>Gen. Geology. | (168) | 3. |
| Military Drill | | 1. | Military Drill | | 1. |

SUMMER COURSES—Civil Engineering (104 and 111), each four weeks of six days per week. Four credit hours for each course. Field work in Surveying. Required in second and third years respectively.

### THIRD YEAR

| FIRST SEMESTER | | | SECOND SEMESTER | | |
|---|---|---|---|---|---|
| Mechanics<br>Statics and Str. of Mater'ls. | (101) | 5. | Mechanics<br>Kinetics and Hydraulics. | (102) | 5. |
| Civil Engineering<br>Topographic Surveying. | (105) | 3. | Civil Engineering<br>Timber Construction. | (108) | 3. |
| Civil Engineering<br>Stereotomy. | (107) | 3. | Civil Engineering<br>Roads and Streets. | (106) | 3. |
| Civil Engineering<br>Sanitary Eng. | (109) | 2. | Civil Engineering<br>Stresses in Structure. | (110) | 4. |
| Electrical Eng.<br>Elementary Eng. | (103) | 3. | Astronomy<br>Geodesy and Least Squares. | (104) | 3. |
| Architecture<br>Photography. | (111) | 2. | | | |

### FOURTH YEAR

| FIRST SEMESTER | | | SECOND SEMESTER | | |
|---|---|---|---|---|---|
| Civil Engineering<br>Bridge Design. | (113) | 4. | *Civil Engineering<br>Adv. Bridges. | (114) | 4. |
| Civil Engineering<br>Cement and Concrete. | (118a) | 3. | *Civil Engineering<br>Railways. | (112) | 4. |
| Civil Engineering<br>Masonry Construction. | (115) | 3. | Civil Engineering<br>Masonry Structures. | (116) | 3. |
| Astronomy<br>Geodesy and Least Squares. | (105) | 3. | Civil Engineering<br>Water Supply. | (117) | 3. |
| Mechanical Eng.<br>Laboratory. | (173) | 5. | Civil Engineering<br>Contracts and Spec. | (120) | 2. |
| Civil Engineering<br>Thesis. | (119) | 1. | Mechanical Eng.<br>Mechanism and Mach. Des. | (140) | 2. |
| | | | Civil Engineering<br>Thesis. | (122) | 4. |

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*Alternative Course. One must be taken.

## ELECTRICAL ENGINEERING

While there are few industries into which the application of electricity does not enter, there are several, such as electric railways, lighting and power, telephony and telegraphy, railroad signaling, shop drive, etc.,and the manufacture of electrical machinery, which call especially for an electro-technical training.

Electricity and electrical machinery naturally constitute the most important studies of this course. This work begins in the second year in the physics department. In the third year it occupies nearly half of the time, and includes electrical measurements, direct current dynamo machinery, applications of electricity, and an introduction to alternating current apparatus. In all of this work the laboratory plays an important part. In the fourth year, the study of alternating current apparatus in class room and dynamo laboratory runs throughout the year, as does also design of dynamo machines. Short courses are also given in transmission, railways, telephones, illumination, and wireless telegraphy.

Besides the courses in drawing of the first year, practise is obtained later in the technical course. Work in carpentry, forging, and the machine shop occupies four weeks of continuous time in the first summer and continues during the second year.

Since the electrical engineer must be also a good mechanical engineer, courses in mechanism, mechanical laboratory, power plants, engines and boilers, and machine design are distributed over the last two years. There are also some electives in the fourth year. An important feature is the two inspection trips which are required in the junior and senior years.

## COURSE IN ELECTRICAL ENGINEERING

FOR FIRST YEAR, SEE PAGE 17

### SECOND YEAR

| FIRST SEMESTER | | | SECOND SEMESTER | | |
|---|---|---|---|---|---|
| Mathematics<br>Calculus. | (141) | 5. | Mathematics<br>Calculus. | (142) | 5. |
| Physics<br>Mechanics and Heat. | (113) | 5. | Physics<br>Elec. Light and Sound. | (114) | 5. |
| Engineering Drawing<br>Descriptive Geometry. | (103) | 3. | Physics<br>Laboratory. | (134) | 3. |
| Physics<br>Laboratory. | (133) | 2. | Engineering Drawing<br>Machine Sketching. | (110) | 2. |
| Shopwork<br>Machine Work. | (119) | 3. | Shopwork<br>Adv. Machine Work. | (122) | 3. |
| Military Drill | | 1. | Military Drill | | 1. |

### THIRD YEAR

| | | | | | |
|---|---|---|---|---|---|
| Mechanics<br>Statics and Str. of Materials. | (101) | 5. | Mechanics<br>Kinetics and Hydraulics. | (102) | 5. |
| Physics<br>Laboratory. | (135) | 5. | Electrical Eng.<br>D. C. Machinery. | (104) | 5. |
| Mechanical Eng.<br>Steam Power Plants. | (103) | 3. | Mechanical Eng.<br>Steam Engines. | (118) | 3. |
| Mechanical Eng.<br>Mechanism. | (101) | 3. | Mechanical Eng.<br>Laboratory. | (160) | 2. |
| Engineering Drawing<br>Technical. | (111) | 2. | Electrical Eng.<br>Applications, A. C. Prin. | (106 & 108) | 3. |
| | | | Electrical Eng.<br>Inspection Trip. | (132) or (136) | |

### FOURTH YEAR

| | | | | | |
|---|---|---|---|---|---|
| Mechanical Eng.<br>Laboratory. | (175) | 3. | Electrical Eng.<br>A. C. Laboratory. | (112) | 3. |
| Electrical Eng.<br>A. C. Laboratory. | (111) | 3. | Electrical Eng.<br>Transmission. | (124) | 3. |
| Electrical Eng.<br>A. C. Machinery. | (109) | 3. | Industrial Arts<br>Machine Design. | (112) | 2. |
| Electrical Eng.<br>Elec. Machine Design. | (121) | 3. | Electrical Eng.<br>Inspection Trip. | (132) or (136) | |
| Electrical Eng.<br>Thesis. | (127) | 1. | Electrical Eng.<br>Thesis. | (128) | 5. |
| Electrical Engineering | (*) | 2. | | | |
| Elective | | 2 to 4. | Elective | | 2 to 5. |

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*One of the following: (113) Railways, (115) Telephones, (117) Illumination, (119) Wireless Telegraphy.

## MECHANICAL ENGINEERING

Mechanical engineering in its broadest meaning includes the invention, development, design, manufacture, and operation of all forms of machinery.

Apart from drawing and shopwork, the technical work in mechanical engineering begins in the first semester of the third year, with a descriptive course on power plants and followed by a more advanced course in steam engineering, accompanied by laboratory work and recitations and drawing practise in the principles of mechanism and mechanical movements. In the fourth year the steam engineering work is continued with courses on gas engines and thermodynamics. A laboratory course runs throughout the fourth year, and covers the testing of materials of construction, steam, hot-air, and gas engines, power transmission, boilers, injectors, air compressors, pumps. and other hydraulic apparatus. The course in machine design runs through the year with lectures, recitations, and drawing-room practise in the applications. Courses on hydraulic machinery, and upon shop buildings and steam turbines, complete the list of mechanical engineering subjects.

Allied courses are given in the chemistry of fuels, the metallurgy of iron and steel, timber and masonry constructions, the design of trusses, differential equations, electrical machinery, and photography.

The two inspection trips, which are required in the third and fourth years, are an important feature. A thesis, giving the results of a piece of original work, is required. A special bulletin describing this department will be mailed on request. Address the University Editor.

## COURSE IN MECHANICAL ENGINEERING

FOR FIRST YEAR, SEE PAGE 17.

### SECOND YEAR

| First Semester | | | Second Semester | | |
|---|---|---|---|---|---|
| Mathematics<br>Calculus. | (141) | 5. | Mathematics<br>Calculus. | (142) | 5. |
| Physics<br>Mechanics and Heat. | (113) | 5. | Physics<br>Electricity and Light. | (112) | 3. |
| Engineering Drawing<br>Descriptive Geometry. | (103) | 3. | Engineering Drawing<br>Machine Sketching. | (104) | 3. |
| Shopwork<br>Foundry. | (105) | 2. | Shopwork<br>Machine Work. | (120) | 3. |
| Shopwork<br>Chipping and Filing. | (107) | 2. | Physics<br>Laboratory. | (138) | 2. |
| Shopwork<br>Adv. Pattern Making. | (111) | 1. | Civil Engineering<br>Surveying. | (128) | 2. |
| Military Drill | | 1. | Military Drill | | 1. |

### THIRD YEAR

| | | | | | |
|---|---|---|---|---|---|
| Mechanics<br>Statics and Str. of Materials. | (101) | 5. | Mechanics<br>Kinetics and Hydraulics. | (102) | 5. |
| Engineering Drawing<br>Technical Drawing. | (111) | 2. | Architecture<br>Photography. | (112) | 2. |
| Metallurgy<br>General Metallurgy. | (109) | 4. | Civil Engineering<br>Timber and Masonry. | (126) | 2. |
| Mathematics<br>Diff. Equations. | (151) | 1. | Mech. Eng.<br>Mechanism and Drawing. | (114 and 116) | 3 and 1. |
| Shopwork<br>Adv. Machine Work. | (121) | 3. | Mech. Eng.<br>Steam Engines and Boilers. | (118 and 120) | 3 and 1. |
| Mechanical Eng.<br>Steam Power Plants. | (103) | 3. | Mechanical Eng.<br>Laboratory. | (164) | 2. |
| | | | Mechanical Eng.<br>Inspection Trip. | (132 or 136). | |

### FOURTH YEAR

| | | | | | |
|---|---|---|---|---|---|
| Civil Engineering<br>Trusses. | (123) | 3. | *Industrial Arts<br>Shop Buildings. | (114) | 2 |
| Electrical Eng.<br>Elementary Elec. Eng. | (101) | 5. | *Mechanical Eng.<br>Steam Turbines. | (146) | 2. |
| Mechanical Eng.<br>Machine Design. | (127) | 5. | Mechanical Eng.<br>Machine Design. | (144) | 5. |
| Mechanical Eng.<br>Gas Engines and Producers. | (125) | 2. | Mechanical Eng.<br>Hydraulic Machinery. | (142) | 2. |
| Mechanical Eng.<br>Thermodynamics. | (129) | 2. | Mechanical Eng.<br>Laboratory. | (190) | 6. |
| Mechanical Eng.<br>Laboratory. | (179) | 2. | Mechanical Eng.<br>Thesis. | (148) | 3. |
| | | | Mechanical Eng.<br>Inspection Trip. | (132 or 136). | |

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*Alternative Courses. One must be taken.

## MINE ENGINEERING

The profession of mine engineering, which has for its main object the development and winning of mineral resources, is closely connected with that of metallurgy.

The special work in mine engineering proper begins in the second year with mine surveying in which in addition to the instruction at the University, practise is given in actual surveying of mines and quarries accessible to Columbus. In the fourth year a course of lectures treats of the problems of mine engineering involved in opening, developing, and equipping mining plants, and the prospecting, location, and examination of mineral property and mining plants.

Special work is given on efficiency in the operation of mining plants. Special attention is given to costs of production, and of practical ways of reducing the costs of mining. Special work is given on mine power plants and the efficient use of power at mining plants.

The special work in metallurgy begins in the second semester of the second year and comprises courses in the metallurgical laboratory, and one semester in mineralogy and crystallography. In the third year a course of lectures for both semesters treats of the principles of combustion, the valuation and the treatment of fuels, and the extraction and preparation of iron, steel, and other metals, including gold and silver. There is also work in the advanced metallurgical laboratory, where special analytical methods, coal washing, and ore dressing are studied by lectures and laboratory practise, also calorimetry and the microscopic examination of metals. In this year there is a one-semester course in determinative mineralogy and a one-semester laboratory course in the fire assaying of gold, silver, and other ores. In the fourth year there is a course in connection with the department of mine engineering on metallurgical construction covering the design of furnaces and other metallurgical machinery, and a course of lectures on ore dressing and coal washing.

## COURSE IN MINE ENGINEERING

FOR FIRST YEAR, SEE PAGE 17

### SECOND YEAR

| First Semester | | | Second Semester | | |
|---|---|---|---|---|---|
| Mathematics<br>Calculus. | (141) | 5. | Mathematics<br>Calculus. | (142) | 5. |
| Physics<br>General Physics. | (111) | 3. | Physics<br>General Physics. | (112) | 3. |
| Engineering Drawing<br>Descriptive Geometry. | (103) | 3. | Engineering Drawing<br>Machine Sketching. | (104) | 3. |
| Chemistry<br>Quantitative Analysis. | (119) | 3. | Metallurgy<br>Laboratory. | (106) | 4. |
| Mine Engineering<br>Mine Surveying. | (103) | 4. | Mineralogy<br>Mineralogy and Cryst'g'phy. | (102) | 3. |
| | | | Mine Engineering<br>Mine Trip. | (110) | 1. |
| Military Drill | | 1. | Military Drill | | 1. |

### THIRD YEAR

| | | | | | |
|---|---|---|---|---|---|
| Mechanics<br>Statics and Str. of Mater'ls. | (101) | 5. | Mechanics<br>Kinetics and Hydraulics. | (102) | 5. |
| Metallurgy<br>Gen. Metallurgy. | (109) | 4. | Metallurgy<br>Gen. Metallurgy. | (110) | 4. |
| Metallurgy<br>Fire Assaying. | (105) | 3. | Metallurgy<br>Calorimetry, Mine Gas Anal. | (112) | 2. |
| Metallurgy<br>Laboratory. | (107) | 4. | Mineralogy<br>Determinative Mineralogy. | (104) | 3. |
| Geology<br>Gen. Geology. | (165) | 3. | Geology<br>Petrography. | (166) | 2. |
| | | | Civil Engineering<br>Trusses. | (124) | 3. |

### FOURTH YEAR

| | | | | | |
|---|---|---|---|---|---|
| Mine Engineering<br>General Mining. | (105) | 5. | Mine Engineering<br>Gen. Mining. | (106) | 5. |
| Metallurgy<br>Metallurgical Const. | (111) | 2. | Mine Engineering<br>Plans and Specifications. | (104) | 4. |
| Metallurgy<br>Ore Dressing. | (113) | 2. | Metallurgy<br>Metallography, etc. | (114) | 3. |
| Electrical Eng.<br>Elementary Elec. | (103) | 2. | Mechanical Eng.<br>Laboratory. | (192) | 3. |
| Geology<br>Economic Geology. | (167) | 3. | *Mine Engineering<br>Thesis. | (116) | 3. |
| Architecture<br>Photography. | (111) | 2. | *Metallurgy<br>Thesis. | (116) | 3. |

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*Alternative courses. One must be taken.

## COMBINATION COURSES

Combination courses, leading to two engineering degrees, can be arranged for any two of the foregoing degrees. The amount of additional time will be at least thirty semester hours in excess of that required for one, and may be more. In no case will the student be required to take all of the work not common to the two courses as published.

For instance a joint course, Mechanical and Electrical Engineering, can be made in five years. Between courses more unlike, such as Civil Engineering and Mechanical Engineering, six years would be required.

## ARTS-ENGINEERING COURSES

For the benefit of those who desire to possess the advantage of a wider general culture and a broader foundation than can be given in the limits of a four-year professional course, a combination of three years in the College of Arts, Philosophy, and Science and three years in the College of Engineering can be so adjusted as to enable the student to secure both the Bachelor of Arts and Bachelor of the appropriate engineering course. The College of Engineering desires to establish similar relations with other educational institutions of approved standing in Ohio and elsewhere by which students can win two degrees in five or six years.

## GRADUATE WORK

The Graduate School has administrative control of the whole subject of graduate work in all of the colleges of the University. The conditions under which advanced degrees can be obtained by graduates of the College of Engineering are as follows:

**Master's Degree.** The degree which will usually be conferred upon candidates whose major work lies in the College of Engineering will be that of Master of Science, (M. Sc.). The course of study will consist of one major and either one or two minors, at least one of the minors being in a different department from that in which the major is taken. A residence of one year devoted wholly to graduate work is required, but graduates of this University may do not to exceed one-half of the required work at another institution offering equivalent opportunities for study. Except in certain special cases, a satisfactory thesis is required.

**Professional Engineering Degrees.** Upon nomination by the Faculty of the College of Engineering, the appropriate professional engineering degree of Civil Engineer, Mechanical Engineer, Electrical Engineer, Engineer of Mines, Ceramic Engineer, Chemical Engineer, or Master of Architecture, may be granted to graduates of this University upon any one of the following plans:

First. Four years of acceptable professional experience and an approved thesis.

Second. A Master of Science degree from this University with a major in engineering, followed by two years of acceptable professional experience and an approved thesis.

Third. One year of acceptable professional experience, followed by one year of approved study at this University, with an appropriate engineering major, and the submitting of an approved thesis.

## COURSES NOT LEADING TO A DEGREE

The following short courses, of two years each, are offered by the College of Engineering to meet the needs of that class of young men who have for some reason failed to qualify themselves to enter the regular four-year courses, but whose experience in engineering work has shown them the need of some technical education as a requisite to further progress. These courses are in no sense a substitute for the regular four-year courses, nor are they designed as preparation for subsequent entrance into the regular courses. They aim to give an introduction to the fundamentals of engineering only, and in the shortest time consistent with any real educational result.

Applicants for admission to these courses are required to have at least two years of consecutive practical experience in some branch of the industries related to the one they wish to pursue, and to present a satisfactory certificate to that effect. (See page 16).

# SHORT COURSE IN CLAYWORKING

## FIRST YEAR

| FIRST SEMESTER | | SECOND SEMESTER | |
|---|---|---|---|
| Mathematics (101)<br>Elementary Algebra. | 5. | Mathematics (102)<br>Elementary Algebra. | 5. |
| Chemistry (101)<br>Elementary Chemistry. | 4. | Chemistry (102)<br>Elementary Chemistry and Qualitative Analysis. | 4. |
| Engineering Drawing (113)<br>Freehand and Lettering. | 4. | Engineering Drawing (114)<br>Mechanical Drawing. | 3. |
| Ceramic Engineering (141)<br>Occurrence and Winning of Clays. | 3. | Ceramic Engineering (142)<br>Preparation and Forming of Clay Wares. | 3. |
| Military Drill | 1. | Military Drill | 1. |
| Gymnasium | 1. | Gymnasium | 1. |

SUMMER SESSION—*Students are required to take two of the following subjects: Shopwork (107), (109), and (115), during the Summer Session at the close of the first year.

## SECOND YEAR

| | | | |
|---|---|---|---|
| Ceramic Engineering (101)<br>Ceramic Chemistry. | 4. | Ceramic Engineering (102)<br>Ceramic Chemistry | 3. |
| Ceramic Engineering (143)<br>Drying and Burning of Clay Wares. | 3. | Ceramic Engineering (144)<br>Glazing and Decorating of Clay Wares. | 3. |
| Ceramic Engineering (105)<br>Calculations. | 2. | Ceramic Engineering (126)<br>Laboratory. | 5. |
| Ceramic Engineering (115)<br>Laboratory. | 2. | Ceramic Engineering (122)<br>Dryer and Kiln Design. | 4. |
| Physics (101)<br>Elementary Physics. | 6. | | |
| Military Drill | 1. | Military Drill | 1. |

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*Upon presentation of reasons satisfactory to the head of the department students may substitute work in a ceramic factory for the above shopwork courses.

## SHORT COURSE IN INDUSTRIAL ARTS

### FIRST YEAR

| FIRST SEMESTER | | | SECOND SEMESTER | | |
|---|---|---|---|---|---|
| Mathematics | (101) | 5. | Mathematics | (102) | 5. |
| Elementary Algebra. | | | Elementary Algebra. | | |
| Mathematics | (113) | 5. | Mathematics | (114) | 5. |
| Plane and Solid Geom. | | | Solid Geom. and Trig. | | |
| Engineering Drawing | (113) | 4. | Engineering Drawing | (114) | 3. |
| Freehand and Lettering. | | | Mechanical Drawing. | | |
| Shopwork | (109) | 2. | Shopwork | (112) | 1. |
| Pattern Making. | | | Adv. Pattern Making. | | |
| Shopwork | (115) | 2. | Shopwork | (106) | 2. |
| Forging. | | | Foundry. | | |
| | | | Shopwork | (108) | 2. |
| | | | Chipping and Filing. | | |
| Military Drill | | 1. | Military Drill | | 1. |
| Gymnasium | | 1. | Gymnasium | | 1. |

### SECOND YEAR

| | | | | | |
|---|---|---|---|---|---|
| Engineering Drawing | (103) | 3. | Engineering Drawing | (104) | 3. |
| Descriptive Geometry. | | | Machine Sketching. | | |
| Industrial Arts | (101) | 3. | Industrial Arts | (102) | 3. |
| Machines. | | | Machines. | | |
| Industrial Arts | (103) | 2. | Industrial Arts | (104) | 2. |
| Designing. | | | Designing. | | |
| Physics | (101) | 6. | Industrial Arts | (110) | 6. |
| Elementary Physics. | | | Strength of Materials. | | |
| Shopwork | (119) | 3. | Shopwork | (122) | 3. |
| Machine Work. | | | Adv. Machine Work. | | |
| Military Drill | | 1. | Military Drill | | 1. |

## SHORT COURSE IN MINING

### FIRST YEAR

| First Semester | | | Second Semester | | |
|---|---|---|---|---|---|
| Mathematics<br>Elementary Algebra. | (101) | 5. | Mathematics<br>Elementary Algebra. | (102) | 5 |
| Mathematics<br>Plane and Solid Geom. | (113) | 5. | Mathematics<br>Solid Geom. and Trig. | (114) | 5. |
| Physics<br>Elementary Physics. | (101) | 6. | Shopwork<br>Forging. | (116) | 2. |
| | | | Geology<br>Elementary Physiography. | (162) | 4. |
| Military Drill | | 1. | Military Drill | | 1. |
| Gymnasium | | 1. | Gymnasium | | 1. |

### SECOND YEAR

| | | | | | |
|---|---|---|---|---|---|
| Engineering Drawing<br>Freehand and Lettering. | (113) | 4. | Engineering Drawing<br>Mechanical Drawing. | (114) | 3. |
| Chemistry<br>Elementary Chemistry. | (101) | 4. | Geology<br>Elementary Geology. | (164) | 3. |
| Mine Engineering<br>Mine Plans. | (107) | 2. | Metallurgy<br>Water Supply and Mine Gases. | (102) | 4. |
| Mine Engineering<br>Mine Surveying. | (101) | 5. | Mine Engineering<br>General Mining. | (102) | 5. |
| Military Drill | | 1. | Military Drill | | 1. |

## SHORT COURSE IN HIGHWAY ENGINEERING

The second annual Short Course in Highway Engineering will be given February 16th to 28th inclusive, 1914. Last year the course was given at the request of the Ohio Good Roads Federation and at its expense. This year provision was made for this course by legislative appropriation. It is designed to meet the needs of County Surveyors, County Commissioners, Township Trustees, and Road-drag Superintendents, State Highway Inspectors, and all who are interested in knowing more of good road construction and wish to get some connected and systematic knowledge of the present status of Highway engineering.

It was not designed to create highway engineers, but to try to bring home to the people the necessity of using trained and educated highway engineers, if the best results are to be obtained from the expenditures being made for highways.

### THE COURSE

MONDAY, FEBRUARY 16.

"Good Roads—From the Farmer's View Point" .................. Dean Homer C. Price

"Better Roads—From the Taxpayer's View Point" .. Mr. Jesse Taylor

TUESDAY, FEBRUARY 17.

"Roads in Ohio" ........................... Mr. James R. Marker

"Earth Roads—Their Improvement and Maintenance" .................. Mr. Maurice O. Eldridge

"Gravel and Macadam Roads" ............. Mr. Maurice O. Eldridge

"Alignment and Grades" ................. Professor Roy K. Schlafly

WEDNESDAY, FEBRUARY 18.

"Subgrades and Foundations" ............. Professor Frank H. Eno

"The Road Building Materials of Ohio" .................. Professor Christopher E. Sherman

"What the Road Builder and Engineer Should Know about Road Stone"..............................Mr. Albert T. Goldbeck

Dinner at Ohio Union...........................Road Topic Toasts

THURSDAY, FEBRUARY 19.

"Road Legislation, Present and Future"..................................................Professor Arthur H. Blanchard

"Ohio Road Legislation, Present and Future," Governor James M. Cox

"Bituminous Surfaces and Bituminous Pavements"..............................................Professor Arthur H. Blanchard

"Foreign Highways" (Illustrated)....Professor Arthur H. Blanchard

FRIDAY, FEBRUARY 20.

Concrete Day

"Cement, Sand, and Stone for Concrete"........Mr. Louis C. Sabin

"Concrete for Foundations and Road Structures"...................................................Professor Frank H. Eno

"Cement and Concrete Laboratory." Lecture and Demonstration .......Professor Clyde T. Morris, Professor William S. Hindman

"Concrete Road Construction" (Illustrated)....Mr. Joseph H. Chubb

SATURDAY, FEBRUARY 21.

Inspection Trip to the State Experimental Road, Nelson Avenue, built by the State Highway Department, July to November, 1909. It represents 7 types, 17 forms of Road Construction.

Inspection Trip to the State Experimental Road, on South High Street, built in 1912-13. It represents 8 types and 31 forms of Road Construction.

MONDAY, FEBRUARY 23.

Brick Day

"The Relations of the Engineer to the Manufacturer in the Selection of Paving Brick".............Dean Edward Orton, Jr.

"Brick Pavement Construction"...............Mr. William P. Blair

"Maintenance and Repair of Brick Pavement"...Mr. Frank R. Lander

"Experimental Roads in Ohio and Lessons from Them"................................................Mr. Albert H. Hinkle

"Pavements, Brick and Otherwise" (Illustrated)...................................................Mr. William P. Blair

### TUESDAY, FEBRUARY 24.

Bridges and Drainage

"Culverts and Bridges"...... ..........Mr. Adelbert A. Henderson

"Some Lessons for the Bridge Engineer from the 1913 Flood"... ...................................Mr. John R. Chamberlin

"The Organization and Management of Working Forces on State Highways"...........................Mr. Arthur N. Johnson

"The Necessity for Good Drainage and the Effect of Poor Drainage on Various Types of Roads".........Mr. Arthur N. Johnson

### WEDNESDAY, FEBRUARY 25.

"Lessons in Highway Construction from Wisconsin" ... ....... ...............................Professor Leonard S. Smith

Visit to the Ceramic and Mechanical Laboratories.

"Highway Structures"..................Professor Clyde T. Morris

"Local Materials for Local Roads"........Professor A. D. Williams

"The Construction of Bitulithic Pavements" (Illustrated by moving pictures). .........................Mr. Asa Goddard

### THURSDAY, FEBRUARY 26.

Asphalt Day

"Bitumens"..........................Professor James R. Withrow

"What the Road Builder and Engineer Should Know about Asphalt"..............................Mr. Prevost Hubbard

"Bitumens and Tar in Miscellaneous Forms of Road Construction" ...................................Mr. Philip P. Sharples

Visit to the Road Laboratory of the State Highway Department. Conducted by......................... ....Mr. Abel S. Rea

### FRIDAY, FEBRUARY 27.

"The Use of Miscellaneous Methods and Materials in Highway Construction. .........................Professor Frank H. Eno

"Construction and Maintenance of Highways in the Philippine Islands".. ............................Mr. John W. Graham

"The Asphalt Industry from the Lake to the Finished Road" (Illustrated)...............................Mr. John MacVicar

It is the expectation that a similar course will be offered during February, 1915, but definite announcement can not be made at this time. A special bulletin will be issued on the subject.

## GROUNDS AND BUILDINGS

The grounds of the University are located about two miles north of the Union Station and extend west from High Street for nearly a mile. They may be reached by the car lines on either High Street or Neil Avenue. The campus proper lies along High Street and contains about one hundred acres. To the west of this lies the University farm which, combined with the campus, has an area of 571 acres. As seen from the map (page 2) the thirty-one larger buildings, valued at nearly two million dollars, are situated near the center of the campus about an irregular oval. Three of the buildings, Brown Hall, Lord Hall, and the Robinson Laboratory, located near the power plant in the northwestern portion of the Campus, are used exclusively for the work of the College of Engineering. Besides these, the next three buildings described below are largely used by the students of this college, and the others to a less degree.

A bulletin containing views of the buildings and laboratories in which engineering instruction is given may be obtained by addressing the University Editor.

### BROWN HALL

Of the three buildings which are entirely occupied with the work of the College, the oldest is Brown Hall, a handsome brick structure named after the second Dean of the College of Engineering. This building was completed in 1904 at a cost of $75,000. The main part of this building is 217 by 50 feet, and these are two short wings extending to the rear. It accommodates the departments of Architecture, Civil Engineering, and Engineering Drawing.

### LORD HALL

This building was named after the first Dean of the College of Engineering and Director of the School of Mines, Nathaniel Wright Lord. It was completed in 1906, and cost $85,000. It is 270 feet long by 70 feet wide, with two one-story fireproof wings for the accommodation of furnace work. This building accommodates the departments of Ceramic Engineering, Metallurgy, Mechanics, Mineralogy, and Mine Engineering. The basement, which is wholly above grade, is used for laboratories and there are also a number of laboratories on the first and second floors. These floors also accommodate the lecture rooms, drawing rooms, and offices.

## THE ROBINSON LABORATORY

This is a building of modern shop construction with sawtooth roof, made up of one forty-eight-foot and seven thirty-foot divisions. These, together with enclosed galleries at the sides, make a total length of 310 feet, with a depth of 112 feet. The enclosed galleries and the space under them are used for special laboratories, museums, class rooms, and offices. The central sections which are lighted by skylights with northern exposure, are occupied by the different laboratories of the Mechanical and Electrical Engineering departments, and contain an amphitheatre suitable for demonstration work, which is used by both departments. This building, completed in 1908, cost $75,000, exclusive of equipment, and is one of the most practical laboratory buildings in the country. It is named in honor of Dr. Stillman W. Robinson, first professor of Mechanical Engineering in this University.

## HAYES HALL

This building was named in honor of President Rutherford B. Hayes, at one time a trustee of the University. It is at present occupied by the departments of Industrial Arts and Home Economics. The building, which was completed in 1893, is irregular in shape, with frontage of 166 feet and greatest depth of 144 feet. The central section is occupied by the machine and carpenter shops, foundry, forge room, offices, and drawing rooms.

## CHEMISTRY HALL

In this building is given all the instruction in pure chemistry, and also the technical courses in chemical engineering. The building was completed in 1907, at a cost of $100,000. It has a frontage of 200 feet and a depth of 70 feet, with laboratories, lecture rooms, offices, etc., occupying two stories and a high basement. It has one of the finest equipments in the University. (See also Chemical Engineering).

## PHYSICS HALL

This building is devoted to the work of the Physics Department. It is 105 feet long by 102 feet in its greatest depth, with three stories and a high basement. It was erected in 1906 at a cost of $80,000, and is equipped with forty thousand dollars worth of modern apparatus. A large part of the basement is given to the laboratory work in electrical measurement.

## OBSERVATORY

The Emerson McMillin Observatory is the gift of Emerson McMillin of New York City. It is located in the southern part of the grounds, and is provided with excellent equipment for purely scientific research, or for the teaching of astronomy in its engineering aspects.

## ORTON HALL

This building was erected in 1891 for the Department of Geology and represents in itself the building stones of Ohio, most of the characteristic varieties of which were used in its construction. For the equipment, see Geological Department.

## LIBRARY

A new Library building, costing with its equipment, exclusive of books, $300,000. has been recently completed and is in use. The Library consists of approximately 133,000 volumes. The main part of the books are kept in the Library, but there are important branch libraries in Chemistry in Chemistry Hall; in Mining, Metallurgy and Ceramic Engineering in Lord Hall; in Electrical Engineering and Mechanical Engineering in the Robinson Laboratory; and some smaller ones in other departments.

## UNIVERSITY HALL

In this building, which is the oldest on the grounds, the greater part of the work in mathematics and language is given. This building also contains the offices of the President, the Secretary of the Board of Trustees, and the Registrar.

## GYMNASIUM AND ARMORY

The Gymnasium and Armory is a beautiful building erected in 1898 at the cost of $115,000. Its main floor is 80 by 150 feet clear, and there is a gallery twelve feet above the floor, containing a running track, and seats for about seven hundred persons. The basement contains another gymnasium room 80 x 40 feet, also used by the Military Department a portion of the time for a target range. The men's locker room contains 640 lockers, and the women's, 115. The building is well equipped with gymnastic apparatus, shower baths, and swimming pools for men and for women. The headquarters, officers' quarters, band room, and gun racks of the Military Department are located in this building.

## POWER HOUSE

The University provides the light, heat, and power for all its buildings from a central station. There is a boiler house 38 by 100 feet, with three 150, one 450, and two 500 horse-power watertube boilers, equipped with turbine, steam-driven feed pumps, automatic stokers, and coal and ash-handling apparatus. Fuel is brought to the University over a spur from the Hocking Valley Railway, about three-quarters of a mile long. The cars are unloaded by a locomotive crane, with clam-shell unloader. The coal is dropped by this apparatus into the chutes of the coal-handling system, which carries it to the boilers, or is dumped into concrete coal-storage bins, 40 by 100 feet in area. Near the boiler house is the engine house, 40 by 60 feet, with an L 30 by 40 feet, equipped with the following: two 125 kilowatt two-phase direct-connected steam units, one 100 kilowatt gas engine unit, one 300 kilowatt turbo-generator set, one 15 kilowatt exciter set, and two small air compressors. The hot water heating apparatus located in the L utilizes exhaust steam for heating eight buildings, and consists of the following: one large exhaust heater, one live steam heater, one turbine pump, and one surface condenser. The power and boiler houses are connected through a large tunnel with nearly all the buildings of the University, and through this tunnel run the pipes for steam, water, and gas, as well as the electrical distribution for light and power. The power plant is a strictly modern and efficient equipment, and is of value as an object lesson to all students of engineering.

# THE DEPARTMENTS OF INSTRUCTION

## ARCHITECTURE

Office, Room 22, Brown Hall
PROFESSOR BRADFORD, PROFESSOR CHUBB,
MR. HASKETT, MR. RONAN.

### EQUIPMENT

The department occupies the west end of Brown Hall, where it is provided with large, well lighted designing rooms, a lecture room with projection lantern, library, and office.

In the designing rooms, each student is provided with a drawing table and locker for his exclusive use. The equipment includes a fine collection of plaster casts of architectural orders, carved ornament and statuary, including a set by Caproni from the noted monuments of ancient and mediæval architecture, two thousand lantern slides of the masterpieces of architecture, a collection of large photographs, a collection of portfolios of noted architectural plates, drawings and specifications of erected structures, samples of building materials, fixtures, etc. The department library has a good collection of standard works and bound volumes of the standard periodicals.

The courses in photography are given in this department. The laboratory for this work is one of the best in the country and includes a dark room which will accommodate forty students working at the same time, each with a complete and separate stall. There is a printing and toning room, and also a room for indoor and special work. Equipment of note consists of fourteen high-grade view cameras fitted with fine lenses, also shutters, color screens and exposure meters, a Bausch and Lomb photo-micrographic apparatus of the finest quality, special photographic arc lamps, and three copying cameras. There is an enlarging room equipped for handling any work up to the largest practical sizes, and also a separate blue printing room equipped with a modern cylindrical arc lamp, blue printing machine, also washing tanks, drying racks, etc.

## SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**101. History of Architecture.** Three credit hours. Architecture, second year, first semester, Mr. Chubb.

Lectures, illustrated by lantern slides.

**102.** Continuation of 101. Architecture, second year, second semester. Mr. Chubb.

**103. Order Problems.** Two credit hours. Architecture, second year, first semester. Prerequisite, Engineering Drawing 102, concurrent with Engineering Drawing 107. Mr. Ronan.

**104. Order Problems.** Five credit hours. Architecture, second year, second semester. Prerequisite, Architecture 103. Mr. Ronan.

**107. Design.** Five credit hours. Lectures and practise. Architecture, third year, first semester. Prerequisite, Architecture 104, and concurrent with Architecture 113. Mr. Ronan.

**108. Design.** Four credit hours. Architecture, third year, second semester. Prerequisite. Architecture 107. Mr. Chnbb.

**109. Decoration and Ornament.** Three credit hours. Architecture, third year, first semester. Prerequisite, Architecture 104 and Engineering Drawing 115. Mr. Chubb.

**110. Working Drawings.** Four credit hours. Architecture, third year, second semester. Prerequisite, Architecture, 107. Mr. Chubb, Mr. Ronan.

**111. Photography.** Two credit hours. Civil Engineering, third year, first semester; Mine Engineering, fourth year, first semester. Prerequisite, Chemistry 105, 106, or 109, 110. Mr. Haskett.

**112. Photography.** Two credit hours. Mechanical Engineering and Architecture, third year, second semester. Prerequisite. Chemistry 105, 106, or 109, 110. Mr. Haskett.

**113. Principles of Architectural Composition.** Two credit hours. Architecture, third year, first semester. Concurrent, Architecture 109. Prerequisite, Architecture 102. Mr. Chubb.

**114. Designing.** Three credit hours. Architecture, fourth year, second semester. Prerequisite, Architecture 108. Mr. Chubb, Mr. Ronan.

**115. Designing.** Six credit hours. Architecture, fourth year, first semester. Prerequisite, Architecture 108. Mr. Chubb, Mr. Ronan.

**116. Professional Practise.** Four credit hours. Architecture, fourth year, second semester. Prerequisite, Architecture 115. Mr. Bradford.

**117. Sanitary Plumbing.** One credit hour. Architecture, fourth year, first semester. Mr. Bradford.

**118. Thesis.** Five credit hours. Architecture, fourth year, second semester. Mr. Bradford, Mr. Chubb, Mr. Ronan.

**119. Masonry.** Two credit hours. Architecture, fourth year, first semester. Prerequisite, Architecture 110. Mr. Bradford.

**120. Summer Work.** Four credit hours. The equivalent of four weeks of work in an architect's office, or a problem in design assigned by the department. Between the second and third years.

**121. Summer Work.** Four credit hours. The equivalent of four weeks of work in an architect's office or a problem in design assigned by the department. Between the third and fourth years.

**122. Photography.** Two credit hours. Second semester. Prerequisite, Architecture 111 or 112. Mr. Haskett.

**124. Shades, Shadows, and Perspective.** Three credit hours. Architecture, second year, second semester. Prerequisite, Engineering Drawing 107. Mr. Ronan.

## FOR GRADUATES ONLY

For a complete description of the graduate work, the bulletin o- the Graduate School should be consulted.

**201-202. Advanced Design.** Three to ten credit hours. The year. Library, conference, and drawing room work. Time to be arranged with the instructor. Prerequisite, the permission of the instructor. This course deals with special and complex problems in architectural design, and is under the supervision of Mr. Bradford and Mr. Chubb.

**203-204. Research Work.** Three credit hours. The year. Library and conference work. Time to be arranged with the instructor. Prerequisite, the permission of the instructor. This course deals with problems of architectural history, and is under the supervision of Mr. Bradford and Mr. Chubb.

# ASTRONOMY

Office, Emerson McMillin Observatory

PROFESSOR LORD, ASSOCIATE PROFESSOR MANSON

## EQUIPMENT

The equipment consists of six sextants, two small theodolites, five chronometers, a Riefler standard clock and 2½-inch zenith telescope, by Troughton & Simms. For accurate time or longitude there is provided a 3-inch combined portable transit and zenith telescope, by Saegmuller, and chronograph by Warner & Swasey. For refined azimuth determination there is a theodolite by Troughton & Simms, equipped with 12-inch horizontal and vertical circles, reading to single seconds of arc.

Further equipment comprises a 12½-inch equatorial telescope with mounting by Warner & Swasey, objective by Brashear, and a Universal star spectroscope by Brashear; a position micrometer by Warner & Swasey; a 4-inch portable equatorial by Alvin Clark; comparator by Zeiss, and a set of meteorological instruments. There is also provided a fully equipped instrument shop.

Ten students can work each clear night under constant supervision of the instructor, the inconvenience of open air observations being reduced to a minimum.

## SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**104. Astronomy, Geodesy, and Least Squares.** Three credit hours. Civil Engineering, third year, second semester. Prerequisite, the calculus. Mr. Lord, Mr. Manson.

**105**. Continuation of 104. Three credit hours. Civil Engineering, fourth year, first semester. Mr. Lord, Mr, Manson.

**Note**—For graduate courses, the bulletin of the Graduate School should be consulted.

# CERAMIC ENGINEERING

Office, Room 131, Lord Hall

PROFESSORS ORTON, WATTS, AND ASSISTANT PROFESSOR HARROP,

MR. LYSATT.

## EQUIPMENT

The Department of Ceramic Engineering occupies the western third of Lord Hall. In the basement are a pottery laboratory, a brick machine room, and a room chiefly devoted to the grinding of dry materials. There is also a large store room, and in an attached fire-proof wing a kiln room. On the second floor, besides offices and class-rooms, there is a chemical laboratory and a museum of ceramic products. On the second floor are rooms for physical testing and measurement, advanced thesis work, and drawing.

The facilities of the department comprise a chemical laboratory equipped for forty students and especially suited for mineral analysis; a mechanical outfit for the preparation of clays for pottery manufacture, and the production of the ware itself; machinery for grinding and tempering clays; a plant for the manufacture of brick, tiles, pipes, and hollow goods; a kiln house equipped with three downdraft kilns, using solid fuel, two Caulkins muffle kilns arranged to fire with either oil or gas, several small furnaces for burning cements, testing refractory materials, melting glass, and making fritts, using compressed air and natural gas; and electric furnaces for high temperature work. The lecture room is equipped with a series of wall charts, cases containing a mineral collection and a large number of American and foreign clays, and a collection of upwards of six hundred lantern slides illustrating the occurrence, preparation, and manufacture of clays. A ceramic museum containing a small collection of pottery and clay products has been assembled, mostly by donation. A library of the best literature on ceramic technology, containing about four hundred volumes, is open to students daily from 8 A. M. to 10 P. M.

## SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**101. Ceramic Chemistry.** Four credit hours. Ceramic Engineering and Short Clayworking, second year, first semester. Prerequisite, Chemistry 106 or 110. Mr. Demorest.

Quantitative analysis of limestone and simple minerals.

**102. Ceramic Chemistry.** Four hours credit. Ceramic Engineering, second year, second semester. Prerequisite, Ceramic Engineering 101. Quantitative analysis of clays, fire gases, etc. Mr. Demorest.

**105. Ceramic Calculations.** Two credit hours. Ceramic Engineering, third year, first semester; Short Clayworking, second year, first semester. Prerequisite, Ceramics 101. Mr. Harrop.

Calculations involved in blending of ingredients used in ceramic mixtures; determinations of limits of variation in given series; limits of errors; volume calculations; problems in heat.

**108. Physical and Chemical Measurements of Clays.** Three credit hours. Ceramic Engineering, third year, second semester.

Application of physical chemical laws to fusions of mineral mixtures; determination of melting points; deformation periods; relative viscosity of fused magmas; study of influence of salts on viscosity of slips; etc. Mr. Watts.

**111. Laboratory Work in Ceramics.** Five credit hours. Ceramic Engineering, fourth year, first semester. Prerequisite, Ceramics 108, and 144.

Practise in clay testing and measurement of physical properties of clays; the production of bodies made from single clays and of clays with minerals. In each case the bodies are burned and tested. Mr. Watts.

**112.** Continuation of 111. Five credit hours. Ceramic Engineering, fourth year, second semester. Prerequisite, Ceramics 111.

The production of slips, engobes, and glazes, and the study of the methods of coloring. Mr. Watts.

**113. Ceramic Designing.** Five credit hours. Ceramic Engineering, fourth year, first semester. Prerequisite, Ceramics 144.

Designing, estimating cost of, and writing specifications for kilns and dryers. Mr. Harrop.

**114.** Continuation of 113. Five credit hours. Ceramic Engineering, fourth year, second semester. Prerequisite, Ceramics 113.

The work started in Ceramics 113 is extended to the design and equipment of clay-working plants. Mr. Harrop.

**115. Laboratory Work in Ceramics.** Two credit hours. Short Clayworking, second year, first semester. Concurrent, Ceramics 143.

Testing of clays and minerals employed in clay manufacture and in blending of same for ceramic purposes. Mr. Watts.

**116. Thesis.** Four credit hours. Ceramic Engineering, fourth year, second semester.

**118. Cement Manufacture.** Five credit hours. Alternative with Ceramics 112, Ceramic Engineering, fourth year, second semester. Prerequisites, 102 and 144.

The theory of hydraulicity, the compounding, manufacture, and testing of natural and Portland cements and other hydraulic bodies Mr. Harrop.

**122. Dryer and Kiln Design.** Four credit hours. Short Clayworking, second year, second semester. Prerequisite with Ceramics 105.

A graphic study of dryer and kiln design. Mr. Harrop.

**126. Laboratory Work in Ceramics.** Five credit hours. Short Clayworking, second year, second semester. Prerequisite, Ceramics 115.

The preparation of slips, engobes, and glazes, and the study of the methods of coloring. Mr. Watts.

**141. Ceramic Lectures.** Three credit hours. Ceramic Engineering, second year, first semester; Short Clayworking, first year, first semester. Origin of clays, constitution, properties, and winning of ceramic materials. Mr. Orton, Mr. Harrop.

**142.** Continuation of 141. Three credit hours. Ceramic Engineering, second year, second semester; Short Clayworking, first year, second semester. General principles of the preparation and forming of clay wares. Mr. Orton, Mr. Harrop.

**143. Ceramic Manufacture**. Three credit hours. Ceramic Engineering, third year, first semester; Short Clayworking, second year, first semester. The drying and burning of clay wares. Mr. Orton, Mr. Harrop.

**144.** Continuation of 143. Three credit hours. Ceramic Engineering, third year, second semester; Short Clayworking, second year, second semester. Glazing and decoration of clay wares. Mr. Orton, Mr. Watts.

## FOR GRADUATES ONLY

For a complete description of the graduate work, the bulletin of the Graduate School should be consulted.

**201-202. Research Work.** Three to ten credit hours. The year. Library, conference, and laboratory work. Time arranged with the instructor. Prerequisite, the permission of the instructor in charge.

Research work in analytical and physical chemistry of silicates is conducted under the supervision of Mr. Watts; in mineralogy and geology of clay deposits and testing of clays and clay products, under Mr. Orton; in the production and constitutions of ceramic bodies, under Mr. Watts; in the engineering and designing of structures for ceramic industries, and in the manufacture of cements, under Mr. Harrop.

# CHEMISTRY

Office, 100 Chemistry Hall

PROFESSOR MCPHERSON, EMERITUS PROFESSOR NORTON, PROFESSORS HENDERSON, FOULK, EVANS, AND WITHROW, ASSISTANT PROFESSOR LONG, DR. BOORD, AND DEPARTMENT ASSISTANTS

## EQUIPMENT

*Students expecting to specialize in chemistry should send to the University Editor, Ohio State University, Columbus, Ohio. for the Chemistry Bulletin. This gives in detail, information concerning the courses and the equipment of the laboratories, as well as other matters of interest to those who expect to make chemistry their life work.*

The department of chemistry occupies the greater part of Chemistry Hall. In the basement are two laboratories, each accommodating 500 students in elementary chemistry. There are also laboratories for industrial chemistry, for organic combustion work and a repair shop. On the first floor are the main offices of the department, a large laboratory for organic chemistry accommodating eighty students, a smaller one for research work, a lecture room, a library, and a main store room where all the laboratory and office supplies of the University are kept in stock.

On the second floor is the main lecture room, having a seating capacity of 300, and equipped with lantern, specimens, etc., for demonstration work. On this floor are laboratories for the following lines of work: physical chemistry, general analytical work, advanced inorganic chemistry, and the chemical investigation of water. There are also three small private laboratories, the balance room, a small lecture room, and the electrical room containing the storage batteries, a mercury rectifier, and switchboard. On the upper floor are three recitation rooms. The apparatus for ventilating the hoods and the large still for furnishing distilled water are also located here.

The department is well equipped with all the necessary apparatus for carrying on not only the elementary work in chemistry but advanced and research work as well. The general chemical apparatus is loaned to the student, and no charge is made if it is returned in good order. The laboratories are supplied with all the modern conveniences, and each student has his own locker in which he keeps his apparatus. The storage battery room is connected with the various laboratories so that the current can be utilized wherever needed.

## SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**101. Elementary Chemistry.** Four credit hours. First semester. one lecture, one quiz, six hours laboratory weekly. Short Mining, second year; Short Clayworking, first year.

A general introductory course on the chemistry of the non-metals. It is distinctly elementary in character and is arranged for students in short courses only. No credit is allowed for it in the regular four year courses. Students taking this course should follow with course 102, second semester. Mr. Evans, Mr. Dunlap, Mr. Hummel.

**102. Elementary Chemistry and Qualitative Analysis.** Continuation of Chemistry 101. Short courses. Second semester.

A general introductory course on the chemistry of the metals. The laboratory work deals with the elementary principles of qualitative analysis. The course is arranged for students in short courses only. No credit is allowed for it in the regular four year courses. Mr. Evans, Mr. Day, Mr. Hummel.

**105. Elementary Chemistry.** Four credit hours. First semester. One lecture, one quiz, and six hours laboratory weekly. Taken by first year students in all four year courses who have not presented chemistry as an entrance credit. A general course in the chemistry of non-metals. Mr. Evans, Mr. Day, Mr. Holler.

**106. Elementary Chemistry and Qualitative Analysis.** A continuation of Chemistry 105. Four credit hours. Second semester.

A general course in the chemistry of the metals. The laboratory work is a general introductory course in qualitative analysis. Mr. Evans, Mr. Holler, Mr. Day.

**109. General Chemistry.** Four credit hours. First semester. One lecture, one quiz, and six hours laboratory weekly. Taken by first year students in all four year courses who have presented chemistry as an entrance credit. A general course on the chemistry of non-metals. Mr. Evans, Mr. Hummel, Mr. Hockett, Mr. Schmidt.

**110. General Chemistry and Qualitative Analysis.** A continuation of Chemistry 109. Four credit hours. Second semester.

A general course in the chemistry of the metals. It is more advanced than Chemistry 106. The laboratory work is a general course in qualitative analysis. Mr. Evans, Mr. Hummel, Mr. Hockett, Mr. Schmidt.

**113. Advanced General Chemistry.** Two credit hours. Two lectures weekly. Chemical Engineering, second year, first semester. Prerequisite, Chemistry 106 or 110.

A course on the fundamental topics of general chemistry designed. as a thorough review and extension of the first year courses. Mr. Henderson.

**114. Advanced General Chemistry.** A continuation of Chemistry 113. Two credit hours. Chemical Engineering, second year, second semester. Mr. Henderson.

**117. Qualitative Analysis.** Three credit hours. First semester. One lecture and six hours laboratory weekly. Prerequisite, an acceptable course in general chemistry. Mr. Long.

**119. Quantitative Analysis.** (a) Three credit hours. One lecture and six hours laboratory weekly. Mine Engineering, second year, first semester. (b) Four credit hours. One lecture and nine hours laboratory weekly. Chemical Engineering, second year, first semester. Prerequisite, Chemistry 106 or 110. It is desirable that this course be accompanied by Course 113. Mr. Foulk, Mr. Long.

The elementary principles of gravimetric and volumetric analysis.

**120. Quantitative Analysis.** Four credit hours. One lecture and nine hours laboratory weekly. Chemical Engineering, second year, second semester. Prerequisite, Chemistry 119. A continuation of Chemistry 119 with typical analytical methods in gravimetric and volumetric analysis. This course must be accompanied by Chemistry 124. It is desirable that it be accompanied by Chemistry 114. Mr. Foulk, Mr. Long.

**124. Chemical Problems.** One credit hour. Chemical Engineering, second year, second semester. Mr. Foulk.

Extended practice in the solution of problems pertaining to gravimetric and volumetric analysis. This course is arranged to accompany Chemistry 120.

**136. The Reading of Chemical Literature.** Two credit hours, Chemical Engineering, elective, third year, second semester. Prerequisite, one year of German. Mr. Foulk.

The object of this course is to afford practise in the rapid reading of German chemical literature, the selections being made with special reference to the technical terms of the science.

**140. Thesis.** Four credit hours. Chemical Engineering, fourth year, second semester.

**151. Organic Chemistry.** Two credit hours. Two lectures weekly. Chemical Engineering, third year, first semester. Prerequisite, Chemistry 114 and 120. Mr. McPherson.

General course in organic chemistry.

**152.** Continuation of Course 151. Two credit hours. Two lectures weekly. Chemical Engineering, third year, second semester. Prerequisite, Chemistry 151. Mr. McPherson.

**153. Organic Chemistry.** Two or three credit hours. Six or nine hours laboratory weekly. Chemical Engineering, third year, first semester. Must be accompanied or preceded by Chemistry 151. Mr. McPherson, Mr. Boord.

A general course in the preparation of typical organic compounds.

**154.** Continuation of Course 153. Two or three credit hours. Six or nine hours laboratory weekly. Chemical Engineering, elective third year, second semester. Must be preceded or accompanied by Chemistry 152. Mr. McPherson, Mr. Boord.

**157. Physical Chemistry.** Three credit hours. Three lectures weekly. Chemical Engineering, fourth year, first semester. Ceramic Engineering, third year, first semester. Prerequisite, Chemistry 114, 120, and 152. Mr. Henderson.

This is a general course in physical chemistry.

**158. Physical Chemistry.** Three credit hours. Three lectures weekly. Chemical Engineering, fourth year, second semester. Ceramic Engineering, third year, second semester. A continuation of Chemistry 157. Mr. Henderson.

**162. Physical Chemistry.** Two or three credit hours. Six or nine hours laboratory weekly. Elective, second semester. A laboratory course designed to illustrate the general lecture Course 157-158. Prerequisite or concurrent, Chemistry 157. Mr. Henderson, Mr. Dickson.

**165. Quantitative Analysis.** Advanced course. Two credit hours. First semester. Two recitations. Prerequisite, Chemistry 119-120, or equivalent. Mr. Foulk.

A general survey of the methods of quantitative analysis.

**167. Special Methods of Analysis.** Three to five credit hours. First semester. One lecture and six to twelve hours laboratory work weekly. Chemical Engineering, elective, third year. Prerequisite, Chemistry 119-120.

Selections may be made from gas analysis, microchemical analysis, and spectrum analysis. Time to be arranged.

**168. Qualitative Analysis.** Advanced course. Three to five credit hours. One lecture, six to twelve hours laboratory weekly. Chemical Engineering, elective, third year, second semester. Prerequisite, Chemistry 120, or equivalent. Mr. Foulk.

i Extended work in general qualitative analysis including the more mportant of the rare elements.

**169. Quantitative Analysis.** Advanced course. Three to five credit hours. First semester. One conference and six to twelve hours laboratory weekly. Prerequisite, Chemistry 119-120, or equivalent. Mr. Foulk.

A laboratory course in advanced quantitative analysis.

**176. Sanitary Analysis.** Three credit hours. Two lectures and three hours laboratory weekly. Chemical Engineering, elective third year, second semester, Prerequisite, Chemistry 120, or equivalent. Mr. Long.

A study of the methods of sanitary water analysis and interpretation of results.

**177. Industrial Chemistry.** Two credit hours. First semester. Two lectures weekly. Prerequisite, Chemistry 113-114 and 153. Mr. Withrow.

A general course in the principles underlying the application of chemistry to the problems of the industries.

**178. Industrial Chemistry.** One credit hour. Second semester. One lecture weekly. Prerequisite, Chemistry 177. Mr. Withrow.

**182. Industrial Inspection Trip.** A six-day excursion at a suitable time in connection with Course 177-178 for the inspection of industrial chemical processes in actual operation. The entire expense is about $30. A satisfactory report on the work inspected is required. Mr. Withrow.

**184. Written Reports.** A course of assigned reading upon some industrial chemical process and a written report of the same. This is a substitute for Chemistry 182, but the substitution is only allowed upon presentation of reasons satisfactory to the instructor in charge. Mr. Withrow.

**185. Industrial Chemistry.** Two credit hours. One conference, five hours laboratory work weekly. Prerequisite, Chemistry 119-120. Prerequisite or concurrent, Chemistry 177. A course in industrial chemical research. Mr. Withrow.

**186. Industrial Chemistry.** Three credit hours. One conference, eight hours laboratory work weekly. Prerequisite, Chemistry 119-120. Prerequisite or concurrent, Chemistry 177-178. A course of industrial chemical research and technical analysis. Mr. Withrow.

**187. Inorganic Preparations.** Two or three credit hours. Six or nine hours laboratory work weekly. Chemical Engineering, elective,third year, first semester. Prerequisite, Chemistry 114. A course in the preparation of a limited number of compounds chosen so as to give practise in the different kinds of manipulation involved in the preparation of inorganic compounds. Mr. Henderson. Mr. Dickson.

**188.** Repetition of Course 187. Second semester.

**191. Rare Elements.** Two credit hours. Two lectures weekly. Elective, second semester. Given in 1914-15 and biennially thereafter. Prerequisite, Chemistry 114 and 120. Mr. Henderson.

A general course on the chemistry of the rare elements, including a discussion of their increasing economic importance.

**194. Applied Electro-Chemistry.** Two credit hours. Two lectures weekly. Elective, second semester. Prerequisite or concurrent, Chemistry 158, except by the special permission of the instructor. Mr. Withrow.

A descriptive course covering the application of the electric current in chemical industries.

### Graduate Work

For full information relative to the graduate work offered by this Department, the bulletin of the Graduate School should be consulted.

**201-202. Physical Chemistry.** Three credit hours. The year, or either semester separately. Nine hours laboratory work weekly. Prerequisite, Chemistry 157-158 and 162. Mr. Henderson.

A general course on physico-chemical measurements.

**205-206. Organic Chemistry.** Advanced course. Three to five credit hours. The year. Library, conference and laboratory work. Prerequisite, Chemistry 153–154. Mr. McPherson, Mr. Boord.

Special attention is given to the preparation of organic compounds with reference to yield and purity of products. Extended practise is also given in the quantitative determination of the elements present in organic compounds.

**221. The Phase Rule.** Two credit hours. First semester. Two lectures weekly. Given biennially. Not given 1914-15. Prerequisite, permission of the instructor in charge. Mr. Henderson.

A general course on the Phase Rule including the elements of chemical thermodynamics. Mr. Henderson.

**224. Electro Chemistry.** Two credit hours. Second semester. Two lectures weekly. Given biennially. Not given 1914-15. Prerequisite, permission of the instructor in charge. Mr. Henderson.

**227. Analytical Chemistry.** Two credit hours. First semester. Two lectures weekly. Prerequiste, permission of the instructor. Mr. Foulk.

**231-232. Chemical Seminar.** One credit hour. The year.

All those engaged in giving instruction in the department, together with the fellows and graduate students, meet for an extended discussion of chemical problems of general interest.

**235-236. Research Work.** Five to ten credit hours. The year. Library, conference, and laboratory work. Time arranged with instructor. Prerequisite, permission of the instructor in charge. Research work in organic chemistry is conducted under the supervision of Mr. McPherson, Mr. Evans, and Mr. Boord; in physical and inorganic chemistry under Mr. Henderson; in analytical chemistry under Mr. Foulk and Mr. Long; in industrial and electro-chemistry under Mr. Withrow.

# CIVIL ENGINEERING

Office, Room 33, Brown Hall

PROFESSORS SHERMAN, ENO, AND MORRIS, ASSISTANT PROFESSORS
SCHLAFLY AND HINDMAN, MR. SCHLESINGER,
MR. SLOANE, AND MR. MCCOY

## EQUIPMENT

The department occupies the eastern half of Brown Hall. For drafting, three spacious and well-lighted drawing rooms are provided for the work of the second, third, and fourth-year students, respectively. In each room is a collection of working drawings, prints, maps, etc., gathered from practising engineers, and arranged in suitable file cases for ready consultation by the student. A large blue-print room on the ground floor is equipped with electrical blue-print apparatus, in addition to the ordinary sunlight frames.

For field work, the instruments are one theodolite, eighteen transits fitted for various kinds of surveying, thirteen leveling instruments, plane table, solar compass, solar attachments, high-grade aneroid barometers, drainage levels, surveying camera, rods, chains, tapes, hand-levels, etc. Two current meters with accessories, and a rating course 175 feet long in the rear of the building furnish facilities for carrying on hydrographic work.

The cement-testing laboratory is fitted with necessary appliances for making the ordinary tests. It contains Fairbanks and Riehle tensile testing machines, briquet molds, sieves, apparatus for making hot tests, etc., and a machine for testing plain and reinforced concrete beams.

The department also owns a complete outfit for carrying on in camp the work of summer surveying.

## SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**101. Land Surveying.** Four credit hours. Four recitations weekly. Civil Engineering, second year, first semester. Prerequisite, Mathematics 132, Engineering Drawing 102. Mr. Sherman, Mr. Eno, Mr. Schlafly, Mr. Schlesinger.

Care and use of instruments. Farm, City, and Hydrographic Surveying.

**101a. Field Practise.** One credit hour. Three hours per week in field. Civil Engineering, second year, first semester. Prerequisite, or concurrent, Civil Engineering 101. Field exercises in use of instruments and surveying. Mr. Schlafly, Mr. Hindman, and department instructors.

**102. Railroad Surveying**. Three credit hours. Three recitations per week. Civil Engineering, second year, second semester. Prerequisite Civil Engineering 101 and 101a. Simple, compound, and transition curves, frogs, switches, and earthwork. Mr. Sherman, Mr. Schlafly, Mr. Schlesinger.

**102a. Field Practise.** One credit hour. Three hours per week in field. Civil Engineering, second year, second semester. Prerequisite or concurrent Civil Engineering 102. Field practise in laying out curves, frogs, switches, and earthwork. Mr. Schlafly, Mr. Schlesinger, and department instructors.

**103. Topographic Drawing.** Two credit hours. Six hours per week in drafting room. Civil Engineering, second year, first semester. Prerequisite, Engineering Drawing 102. Exercises in black ink and color topographic drawing. Mr. Sherman, Mr. Eno.

**104. Summer Surveying Camp.** Four credit hours. Civil Engineering, at close of second year. Prerequisite, Civil Engineering 101a and 102a.

Four weeks of six days per week of ten hours per day, from the middle of June to the middle of July.

**105. Topographic Surveying.** Three credit hours. Nine hours per week in field or drawing room. Civil Engineering, third year, first semester. Prerequisite, Civil Engineering 101, 102, and 104. Mr. Schlafly, Mr. Schlesinger.

Field and office work in four or five kinds of topographic surveying.

**106. Roads and Streets.** Three credit hours. Three recitations weekly. Civil Engineering, third year, second semester. Prerequisite, Civil Engineering 102 and 104. Mr. Eno.

**107. Stereotomy.** Three credit hours. Recitations, lectures, and drawing. Civil Engineering, third year, first semester. Prerequisite, Engineering Drawing 106. Mr. Schlafly, Mr. Schlesinger.

**108. Timber Construction.** Three credit hours. Lectures and drawing. Civil Engineering, third year. second semester. Prerequisite, Engineering Drawing 105; concurrent, Mechanics 102. Mr. Schlafly, Mr. Schlesinger.

**109. Sanitary Engineering.** Two credit hours. Two recitations per week. Civil Engineering, third year, first semester. Prerequisite Civil Engineering 102 and 104. Mr. Eno.

**110. Stresses in Structures.** Four credit hours. Four recitations weekly. Civil Engineering, third year, second semester. Prerequisite, concurrent Mechanics 102. Mr. Morris.

**111. Summer Surveying Camp.** Four credit hours. Civil Engineering at close of third year. Prerequisite, Civil Engineering 104 and 105.

Four weeks of six days per week of ten hours per day, from the middle of June to the middle of July.

**112. Railway Location.** Four credit hours. Four recitations per week. Optional with Civil Engineering 114. Civil Engineering, fourth year, second semester. Prerequisite, Civil Engineering 102 and 111 and Mechanics 102. Mr. Sherman.

**113. Bridge Designing.** Four credit hours. Four recitations per week. Civil Engineering, fourth year, first semester. Prerequisite, Civil Engineering 110. Mr. Morris.

**114. Advanced Bridges.** Four credit hours. Four recitations per week. Optional with Civil Engineering 112. Civil Engineering, fourth year, second semester. Prerequisite, Civil Engineering 113. Mr. Morris.

**115. Masonry Construction.** Three credit hours. Three recitations weekly. Civil Engineering, fourth year,first semester. Prerequisite, Civil Engineering 111, Mechanics 102. Mr. Sherman.

**116. Masonry Structures.** Three credit hours. Three recitation, lecture, or drawing periods per week. Civil Engineering, fourth year, second semester. Prerequisite, Civil Engineering 115. Mr. Sherman.

**117. Water Supply.** Three credit hours. Three recitations per week. Civil Engineering, fourth year, second semester. Prerequisite, Civil Engineering 111, Mechanics 102. Mr. Eno.

**118. Cement and Concrete.** Three credit hours. Architecture, Ceramic and Civil Engineering, fourth year, second semester. Prerequisite, Mechanics 102 or 104. Mr. Hindman.

**118a.** Repetition of Course 118 in the first semester. Mr. Hindman. Civil Engineering, fourth year, first semester.

**119. Thesis.** One credit hour. Civil Engineering, fourth year, first semester. Prerequisite, Civil Engineering 110 and 111.

**120. Contracts and Specifications.** Two credit hours. Two recitations or lectures weekly. Civil Engineering, fourth year, second semester. Prerequisite, Civil Engineering 106, 109, and 115. Mr. Adams, Mr. Page. (Law School.) Mr. Eno.

**121. Surveying and Topographic Drawing.** Six credit hours· Forestry, second year, first semester. Prerequisite, Mathematics 114 or 132, and Engineering Drawing 102. Mr. Sloane.

The work will be divided into lectures, recitations, field work, computing, and drawing in such manner as the schedule and weather will permit.

**122. Thesis.** Four credit hours. Civil Engineering, fourth year, second semester. Prerequisite, Civil Engineering 119.

**123. Trusses.** Three credit hours. Lectures, recitations, and drawing. Mechanical Engineering, fourth year, first semester. Drawing the last three or four weeks. Prerequisite, Mechanics 102 or 104. Mr. Hindman.

**124.** Repetition of Course 123. Architecture, Ceramic, and Mine Engineering, third year, second semester. Concurrent Mechanics 102 or 104. Mr. Hindman.

**125. Tall Buildings.** Three credit hours. Three lectures weekly. Architecture, fourth year, first semester. Prerequisite, Civil Engineering 124. Mr. Morris.

**126. Timber and Masonry.** Two credit hours. Two lectures or recitations weekly. Mechanical Engineering, third year, second semester. Prerequisite, Mechanics 101. Mr. Schlesinger.

**128. Plane Surveying.** Two credit hours. One lecture and one field exercise of three hours per week. Architecture, fourth year, second semester; Mechanical Engineering, second year, second semester. Prerequisite, Engineering Drawing 102, Mathematics 132. Mr. Schlesinger, Mr. Sloane, Mr. McCoy.

## FOR GRADUATES ONLY

For a complete description of the graduate work, the bulletin of the Graduate School should be consulted.

**201-202. Investigation and Design.** Three to ten credit hours. The year. Library, conference, and laboratory work. Time arranged with the instructor. Prerequisite, the permission of the instructor in charge. Work in Railroad and Transportation Engineering is conducted under the supervision of Mr. Sherman; in Bridge and Structural Engineering under Mr. Morris; in Municipal and SanitaryEngineering under Mr. Eno; in Stereotomy and Masonry Construction under Mr. Schlafly and Mr. Hindman.

**203-204. Research Work.** Three to ten credit hours. The year. Library, conference, and laboratory work. Time arranged with the instructor. Prerequisite, the permission of the instructor. For division of the field and personnel, see Course 201-202.

# ELECTRICAL ENGINEERING

Office, Room 171, Robinson Laboratory.

PROFESSORS CALDWELL AND FLOWERS, MR. SHEPARDSON, MR. BROWN, MR. MOODY

## EQUIPMENT

This department is located in the north end of the Robinson Laboratory. It has one large dynamo laboratory, 90 x 112 feet, and seventeen smaller rooms. There are also two long balconies used for drafting, computation, and special work.

Among the smaller rooms, the following may be especialy noted: the calibration room is well and conveniently fitted up with standards. These are kept accurate by frequent comparison at the National Bureau of Standards and are at the service of the electrical industries of the State.

There are two telephone laboratories separated by a sound-proof partition. They are well equipped with apparatus of different makes, including a set of Western Electric switchboard apparatus. There is also an artifical 50 mile line, comparison apparatus, and a 5-station 2-wire set from the Automatic Electric Company, and used as an intercommunicating set for the department. The wireless telegraph laboratory has two sending station outfits, one of two and one of five kilowatts, and good receiving apparatus.

The illumination laboratory is fitted for working with light or dark walls; there are photometric outfits and illuminometers. There is a special laboratory used for such work as requires galvanometers and other delicate apparatus. The battery room has a 140-volt and an 8-volt high current battery, with end-cell switching arrangements, etc. There are two small shops fitted up for the construction and repair of apparatus by the department machinist and his helper. The necessary recitation rooms, offices, etc., are provided, and there is a museum with a collection of material illustrating applied electricity.

On the main floor is a space screened off for high potential work, where a 250,000-volt, 50-kilowatt transformer forms a part of the equipment. To this has been recently added, through the generosity of Mr. R. D. Mershon, of New York, the apparatus used by him in his important investigations on high voltage conductors at Niagara. This includes a double 100,000 volt transformer, an alternator, and a valuable collection of standard and special measuring instruments. A Tesla transformer built by the department, capable of giving a 50-inch discharge, is available for high frequency experiments. Preparation has been made for apparatus suitable for running and testing in the laboratory a complete interurban car. The dynamo equipment of over eighty generators and motors, both alternating and direct current, aggregates over 800 horsepower capacity, and includes all important commercial types. A liberal equipment of measuring instruments of various kinds is available, including potentiometer, oscillograph, tachometers, frequency meters, etc.

## SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**101. Electrical Engineering.** Five credit hours. Three lectures and one four-hour laboratory period weekly. Chemical Engineering and Mechanical Engineering, fourth year, first semester. Prerequisite, Physics 112 or Physics 114. Mr. Shepardson.

Lectures and laboratory work on direct and alternating current circuits, dynamo machinery, transformers, accumulators, and their applications.

**103. Electrical Engineering.** Three credit hours. Two lectures and one three-hour laboratory period weekly. Civil Engineering, third year; Mine Engineering, fourth year, first semester. Prerequisite, Physics 112 or 114. Mr. Flowers, Mr. Shepardson.

Lectures and laboratory work on direct current machinery, circuits, and transmission.

**104. Direct Current Machinery.** Five credit hours. Three lectures and one four-hour laboratory period weekly. Electrical Engineering, third year, second semester. Prerequisites, Physics 135, Mathematics 142, and Mechanics 101. Mr. Flowers, Mr. Shepardson.

Generators and motors, a study of their theory, construction, and operation. Lectures, recitations, problems, and laboratory.

**106. Applications of Electricity.** Three hours, for one-half semester. Three lectures per week. Electrical Engineering, third year, second semester. Prerequisites, Physics 135 and Mathematics 142. Mr. Caldwell.

A brief treatment of the uses of electricity, illumination, railways, mining, etc.

**108. Alternating Current Circuits and Machinery.** Three hours, for one-half semester. Electrical Engineering, third year, first half of second semester. Prerequisites, Mathematics 142, Physics 135, Mechanics 101; concurrent, Electrical Engineering 104. Mr. Caldwell.

General principles, circuits, generators, and transformers.

**109. Alternating Current Machinery.** A continuation of Electrical Engineering 108. Three credit hours. Three lectures weekly. Electrical Engineering, fourth year, first semester. Prerequisite, Electrical Engineering 108; concurrent, Electrical Engineering 111.

Transformers, synchronous motors, induction motors, etc. Mr. Caldwell.

**111. Alternating Current Laboratory.** Three credit hours. Electrical Engineering, fourth year, first semester. Prerequisite, Electrical Engineering 108; concurrent, Electrical Engineering 109.

Alternating current apparatus and accumulators. Mr. Brown.

**112. Advanced Alternating Current Laboratory.** Three credit hours. Electrical Engineering, fourth year, second semester. Prerequisite, Electrical Engineering 109 and 111. Mr. Brown.

**113. Electrical Railways.** Two credit hours. Electrical Engineering, fourth year, first semester. Alternative with Electrical Engineering 115, 117, and 119. Prerequisite, Electrical Engineering 104; concurrent, Electrical Engineering 109. Mr. Caldwell.

Systems, apparatus, and operation.

**115. Telephony.** Two credit hours. Electrical Engineering, fourth year, first semester. Alternative with Electrical Engineering 113, 117, and 119. Prerequisites, Electrical Engineering 104 and 108. Mr. Flowers.

Methods of operation, simple circuits and apparatus, elements of transmission theory.

**117. Electric Illumination.** Two credit hours. Electrical Engineering, fourth year, first semester. Alternative with Electrical Engineering 113, 115, and 119. Prerequisites, Electrical Engineering 104 and 108. Mr. Caldwell.

Principles of illumination, electric lamps, wiring plans, etc.

**119. Wireless Telegraphy.** Two credit hours. Electrical Engineering, fourth year, first semester. Alternative with Electrical Engineering 113, 115, and 117. Prerequisites, Electrical Engineering 104 and 108. Mr. Brown.

Elementary theory, production, transmission, and detection of damped and undamped oscillations.

**121. Electrical Design.** Three credit hours. Two three-hour drawing periods weekly. Electrical Engineering, fourth year, first semester. Prerequisite, Electrical Engineering 104. Mr. Flowers.

Direct current dynamos, transformers, etc.

**122. Electrical Design.** Two credit hours. A continuation of Electrical Engineering 121. Two three-hour drawing periods weekly. Electrical Engineering, fourth year, second semester. Elective. Mr. Flowers.

Alternating current apparatus.

**124. Electrical Transmission and Distribution.** Two credit hours. Two lectures weekly. Electrical Engineering, fourth year, second semester. Prerequisite, Electrical Engineering 109. Mr. Caldwell.

Systems, apparatus, and operation.

**125. Special Reading and Laboratory.** Credit hours to be arranged. Elective for fourth year electrical engineering and graduate students with consent of the instructor in charge. First semester. Prerequisites, Electrical Engineering 104 and 108.

**126. Special Reading and Laboratory.** A continuation of Electrical Engineering 125. Second semester.

**127. Thesis.** One credit hour. Electrical Engineering, fourth year, first semester. Prerequisites, Electrical Engineering 104 and 108.

**128. Thesis.** Five credit hours. Electrical Engineering, fourth year, second semester.

**130. Inspection Trip to the East.** April 26 to May 3, 1914. Electrical Engineering, third and fourth year. Given only in the even years.

Includes Pittsburg, Buffalo, Niagara, and Cleveland. The entire expense need not exceed $32. A satisfactory written report on the work of the trip and an examination are required.

**132. Inspection Trip West.** April 25 to May 2, 1915. Electrical Engineering, third and fourth year. Given only in the odd years.

Includes Chicago, Milwaukee, and Gary. The entire expense need not exceed $32. A satisfactory written report on the work of the trip and an examination are required.

**134. Reading Course.** Electrical Engineering, third and fourth years. This may be taken as a substitute for Electrical Engineering 130 on presentation of reasons satisfactory to the head of the department.

Assigned reading on processes of manufacture and power plants.

**136. Reading Course.** Electrical Engineering, third and fourth years. This may be taken as a substitute for Electrical Engineering 132 on presentation of reasons satisfactory to the head of the department.

**138. Advanced Laboratory.** Two credit hours. One four-hour laboratory period. Electrical Engineering, fourth year, second semester. Elective. Mr. Caldwell.

Selected tests on alternating currents, dynamos, illumination, railways, etc.

## FOR GRADUATES ONLY

For a complete description of the graduate work, the bulletin of the Graduate School should be consulted.

**201-202. Advanced Alternating Current Machinery.** Two credit hours. The year. Mr. Caldwell.

An advanced course in the theory of alternating currents and alternating current apparatus.

**203-204. Transient Electrical Phenomena.** Two credit hours. The year. Mr. Flowers.

A course in the theory of the transient phenomena occurring in electrical machinery and transmission lines.

**205-206. Advanced Alternating Current Dynamo Laboratory.** Two credit hours. The year. Mr. Caldwell, Mr. Brown.

An advanced laboratory study of alternating current apparatus.

**207-208. Research Work.** Three to five credit hours. The year. Time to be arranged with the instructor. Prerequisite, permission of the instructor in charge. Library, conference, and laboratory work.

Research work in advanced alternating currents is given under the supervision of Mr. Caldwell and Mr. Brown; in dynamo design, under Mr. Flowers; in telephony, under Mr. Flowers; in illumination, under Mr. Caldwell; in wireless telegraphy, under Mr. Brown.

## ENGINEERING DRAWING

Office, Room 42, Brown Hall

PROFESSOR FRENCH, ASSISTANT PROFESSOR MEIKLEJOHN, MR. WILLIAMS, MR. HARPER, MR. SHEETS, MR. IVES, MR. TURNBULL, MR. GILBERT, MR. NORRIS

### EQUIPMENT

For Engineering Drawing there are four large, well-lighted drawing rooms in Brown Hall, one in Hayes Hall, and one in Page Hall, equipped with individual drawing tables, and lockers, and two lecture rooms, with electric projection lantern. A blue print room is provided with electric light printing machine and sun frames. There is a good set of models illustrating intersections and warped surfaces, and a large collection of machine parts, small machines, patterns, core boxes and models, with a case of machinists' tools such as calipers, scales, surface gauges, etc., for use in machine sketching.

The department has an equipment of many special instruments for illustration and use, such as Universal drafting machines, Kelsey drafting rigs, suspended pantograph, Ockerson machine, different types of section liners, lineads, curves, proportional dividers, protractors, special pens, etc.

Hand books, data sheets, catalogues, and typical examples of shop drawings are available for student use.

The library contains an unusually extensive collection of books on descriptive geometry, machine design, graphics, perspective, and lettering.

### SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**101. Elementary Mechanical Drawing.** Two credit hours. All four-year courses, first year, first semester. Mr. French and department instructors.

Practise in the use of drawing instruments, elementary projections.

**102. Mechanical Drawing.** Three credit hours. All four-year courses, first year, second semester. Prerequisite, Drawing 101. Lettering, orthographic, isometric, and oblique projections. Mr. French and department instructors.

**103. Descriptive Geometry.** Three credit hours. Two recitations, one drawing period weekly. Ceramic, Chemical, Electrical, Mechanical, and Mining Engineering, second year, first semester. Prerequisite, Drawing 102 or 114. Mr. French and department instructors.

**104. Machine Sketching.** Three credit hours. One lecture, two drawing periods weekly. Ceramic, Chemical, Mechanical and Mine Engineering, second year, second semester. Prerequisite, Drawing 103. Mr. Williams, Mr. Sheets, Mr. Ives, Mr. Gilbert.

**105. Descriptive Geometry.** Three credit hours. Two lectures, one drawing period weekly. Civil Engineering, second year, first semester. Prerequisite, Drawing 102. Mr. Meiklejohn, Mr. Harper.

**106. Advanced Descriptive Geometry.** Three credit hours. Two lectures, one drawing period weekly. Civil Engineering, second year, second semester. Prerequisite, Drawing 105. Mr. Meiklejohn, Mr. Harper.

**107. Descriptive Geometry.** Three credit hours. Two recitations, one drawing period weekly. Architecture, second year, first semester. Prerequisite, Drawing 102. Mr. Meiklejohn.

**110. Technical Sketching.** Two credit hours. Electrical Engineering, second year, second semester. Prerequisite, Drawing 103. Mr. Williams, Mr. Sheets.

**111 Technical Drawing.** Two credit hours. Mechanical and Electrical Engineering, third year, first semester. Prerequisite, Drawing 104 or 110. Mr. Williams, Mr. Ives.

**113. Free-hand Drawing and Lettering.** Four credit hours. Short courses in Clayworking and Industrial Arts, first year, first semester. Short Mining course, second year, first semester. Mr. Ives.

**114. Mechanical Drawing.** Three credit hours. Short courses in Clayworking, Industrial Arts, first year, second semester. Short Mining, second year, second semester. Prerequisite, Drawing 113. Mr. Ives.

**115. Charcoal from Architectural Ornament.** Two credit hours. Architecture, second year, first semester. Mr. Norris.

**116. Pen Drawing.** Two credit hours. Architecture, second year, second semester. Mr. Norris.

**117. Water Color.** Three credit hours. Architecture, third year, first semester. Mr. Norris.

**118. Charcoal Drawing from the Antique.** Three credit hours. Architecture, third year, second semester. Prerequisite, Drawing 115. Mr. Norris.

**121. Technical Drawing.** Two credit hours. Designing of chemical plants and machinery. Chemical Engineering, third year, first semester. Prerequisite, Drawing 104. Mr. Williams.

**122. Technical Drawing.** Two credit hours. Continuation of 121. Chemical Engineering, third year, second semester. Mr. Williams.

## ENGLISH

PROFESSORS DENNEY, MCKNIGHT, GRAVES, AND DUNCAN, ASSISTANT PROFESSORS COOPER, BECK, MR. CRAIG, MR. DISHONG

**101. Paragraph Writing: Description and Narration.** Two credit hours. First semester. Course 101 will be repeated in the second semester for the benefit of those who fail, the class meeting Saturdays at 9 a. m. Course 101 is also offered in the Summer Session.

**104. Paragraph Writing: Exposition and Argumentation.** Two credit hours. Second semester. Prerequisite, Course 101 Same hours as for Course 101. Course 104 is also offered in the Summer Session.

## GEOLOGY

Office, Room 1, Orton Hall

PROFESSORS PROSSER AND BOWNOCKER, ASSISTANT PROFESSOR HILLS, MR. VERWIEBE, MISS MARK, MR. ROBINSON.

### EQUIPMENT

This department is located in Orton hall, and is noted for its fine museum of geological material. As the collections of the State Geological Survey are permanently located here, the material illustrative of Ohio formations is particularly complete. It is interesting in this connection to know that in the construction of the building a great variety of material contributed from various quarries of Ohio was used. Thus the building itself forms an important part of the geological collections. Good opportunities are provided for the work in the ithologic, stratigraphic, and physiographic laboratories

## SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**162. Elementary Physiography.** Four credit hours. Short Mining, first year, second semester. Miss Mark.

The physiographic features of the earth's surface and the agencies producing them; the atmosphere; the ocean. Recitations, lectures, map work, and field work.

**164. Elementary Geology.** Three credit hours. Short Mining, second year, second semester. Mr. Verwiebe.

Lithological, dynamical, structural, and historical geology. Recitations, lectures, and laboratory work.

**165. General Geology.** Three credit hours. Mine Engineering, third year, first semester; Ceramic Engineering, fourth year, first semester. Mr. Prosser, Mr. Verwiebe.

Structural, dynamical, and historical geology. The lectures are illustrated by maps, specimens, and lantern views. The common rock-forming minerals and rocks are studied in the laboratory. The first half of the semester, field trips Friday afternoon or Saturday morning will alternate with laboratory periods.

**166. Petrography.** Two credit hours. Mine Engineering, third year, second semester. Mr. Bownocker.

A study of hand specimens of igneous, metamorphic, and sedimentary rocks. Lectures and laboratory work.

**167. Economic Geology.** Three credit hours. Mine Engineering, fourth year, first semester. Prerequisite, Geology 165-166. Mr. Bownocker.

The nature and origin of ores; their modes of occurrence and distribution. The non-metals, coal, oil, gas, clay, lime, cement, and building stones. In the discussion of the non-metals emphasis will be laid on the products of Ohio.

**168. General Geology.** Three credit hours. Civil Engineering, second year, second semester. Mr. Prosser, Mr. Verwiebe.

Structural, dynamical, and historical Geology. The lectures are illustrated by maps, specimens, and lantern views. The common rock-forming minerals and rocks are studied in the laboratory. The last half of the semester, field trips Friday afternoon or Saturday morning will alternate with laboratory periods.

## FOR GRADUATES ONLY

For a complete description of the graduate work, the bulletin of the Graduate School should be consulted.

**201-202. Advanced Historical Geology.** Three to five credit hours. The year. Time to be arranged. Laboratory open afternoons 1 to 4. Prerequisite, Geology 105, 106, 107-108, 165, or 168 recommended. Mr. Prosser.

Advanced work in paleontology and stratigraphical geology. Field work to be arranged with individual students and it is recommended that a part of it be done during the summer vacation under the direction of the instructor in charge.

**203-204. Research Work.** Three to five credit hours. The year. Prerequisite, preceding courses in inorganic or historical geology. Field, laboratory, and library study is offered along two lines. Outline of work and time will be arranged with individual students. (a) STRATIGRAPHY AND PALEONTOLOGY. The investigation of some field problem in stratigraphy with laboratory and library study or of some special subject in paleontology. Mr. Prosser. (b) ECONOMIC GEOLOGY. The investigation of some field problem in petroleum, natural gas, coal, or salt. Mr. Bownocker.

## GERMAN

Offices, Rooms 317 and 318, University Hall

PROFESSORS EVANS AND EISENLOHR, ASSISTANT PROFESSORS
THOMAS, BARROWS, LEWISOHN, AND BUSEY, DR. KEIDEL,
MR. KOTZ, AND MR. WILDERMUTH.

**101-102. Elementary German.** Four credit hours. The year. Open to students in any four-year course who enter with a language other than German.

The essentials of grammar and oral practise, first semester.

Reading of easy narrative, grammatical drill, second semester.

**103. Intermediate German.** Four credit hours. Prerequisite, German 102 or two units entrance credit in German. Not open to students who enter with four units entrance credit in German.

Reading of narrative prose, with topical review of grammar. One hour prose composition weekly.

**106. Science Reading.** Four credit hours. Second semester. This course is for engineering students; a continuation of Courses 103 and 107.

Rapid reading of German technical literature. Drill on sentence structure and word formation. The object of the course is to prepare students to read technical works and current technical literature.

**107. Advanced German.** Four credit hours. Open to first year students who enter with four units credit in German. By agreement with the College of Engineering, students may on securing permission continue this course in the second semester in place of 106.

# INDUSTRIAL ARTS AND SHOPWORK

Office, Room 2, Hayes Hall

PROFESSOR SANBORN, ASSOCIATE PROFESSOR KNIGHT,
MR. CASE, MR. BEEM, MR. FOUST, MR. DENMAN,
MR. SMITH, MR. BRECKUR, MR. WRIGHT.

## EQUIPMENT

The carpenter and pattern shops are fitted with well-designed benches, each containing a complete set of the necessary carpenter tools. There are also wood-turning lathes including an eight-foot pattern-makers' lathe. Among the power tools are planers of different kinds and circular, scroll, and band saws. In the forge shop are the usual forges and anvils with the accompanying hand tools and a number of special tools. Among these are a special gas furnace, foot-power hammer, drill, and a combined punch, shear, and bar cutter. The foundry has a twenty-four-inch Colliau cupola, brass furnaces, and a core oven. The room for chipping and filing contains the benches, hand tools, and vises for such work, a power-driven sensitive drill, and a wet tool grinder. The machine shop is furnished with lathes of various types, including a monitor turret lathe, planers, shapers, milling machines, grinding machines, and arbor presses. There is a good equipment of small tools, including a great variety of special ones.

## SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**101. Tools and Machines.** Three credit hours. Three recitations weekly. Short Industrial Arts, second year, first semester. Prerequisite, Mathematics 114 or 132. Concurrent, Physics 101. Mr. Sanborn.

Principles underlying the construction and operation of machines with a special study of machine tools.

**102.** Continuation of 101. Three credit hours. Three recitations weekly. Short Industrial Arts, second year, second semester. Mr. Sanborn.

**103. Designing.** Two credit hours. Two three-hour laboratory periods weekly. Short Industrial Arts, second year, first semester. Concurrent, Industrial Arts 101. Mr. Sanborn.

**104.** Continuation of 103. Two credit hours. Two three-hour laboratory periods weekly. Short Industrial Arts, second year, second semester. Concurrent, Industrial Arts 102. Mr. Sanborn.

**110. Strength of Materials.** Six credit hours. Five recitations and one three-hour laboratory period weekly. Short Industrial Arts, second year, second semester. Mr. Sanborn.

Study of the strength of materials and their use in machines.

**112. Machine Design.** Two credit hours. Two two-hour periods weekly. Electrical Engineering, fourth year, second semester. Prerequisite, Mechanics 102 aud Engineering Drawing 111. Mr. Sanborn.

Practical application of principles of machine design.

**114. Shop Building.** Two credit hours. Two recitations weekly. Alternative with Mechanical Engineering 146, fourth year, second semester. Prerequisite, Civil Engineering 126. Mr. Sanborn.

Lectures and problems on the construction of shop buildings and the arrangement of machinery; special shop appliances.

## SHOPWORK

(The classes in shopwork are carried under a different set of numbers from the preceding theoretical classes in Industrial Arts, though they are in the same department.)

**105. Foundry Work.** Two credit hours. One recitation and two two-hour laboratory periods weekly. Mechanical Engineering, second year, first semester. Mr. Beem, Mr. Breckur.

Exercises and practise on tempering sand and preparing molds of machine parts in sand, core-making, melting iron and brass, and pouring.

**106.** Repetition of Course 105. Short Industrial Arts, first year, second semester. Mr. Beem, Mr. Breckur.

**107. Chipping and Filing.** Two credit hours. One recitation and two two-hour laboratory periods weekly. Mechanical Engineering, second year, first semester. Ceramic Engineering and Short Clayworking, alternative with 109 and 115. Mr. Case.

Exercises and practise in vise work including chipping in cast and wrought iron, surface filing, squaring, fitting, finishing, and the scraping of surface plates.

**108.** Repetition of Course 107. Short Industrial Arts, first year, second semester. Mr. Case.

**109. Joinery and Pattern-Making.** Two credit hours. One recitation and two two-hour laboratory periods weekly. Short Industrial Arts, first year, first semester. Ceramic Engineering and Short Clayworking, alternative with Shopwork 107 and 115, Chemical Engineering, Electrical Engineering, Mechanical Engineering, and Mine Engineering, during the Summer Session at the close of the first year. Mr. Beem, Mr. Denman, Mr. Smith.

Exercises and practise in joinery, wood-turning, and pattern-making, including sawing, planing, mortising, framing, and other work involving the use of the ordinary carpenter tools, center and chuck turning, and making of finished patterns.

**110.** Repetition of Course 109. Mr. Beem, Mr. Denman, Mr. Smith.

**111. Advanced Pattern-Making.** One credit hour. One three-hour laboratory period weekly. Mechanical Engineering second year, first semester. Prerequisite, Shopwork 109. Mr. Beem, Mr. Denman, Mr. Smith.

**112.** Repetition of Course 111. Short Industrial Arts, first year, second semester. Mr. Beem, Mr. Denman, Mr. Smith.

**113. Cabinet-Making.** Two credit hours. Two three-hour laboratory periods weekly. Elective, first semester. Prerequisite, Shopwork 109 or 110. Mr. Beem, Mr. Denman, Mr. Smith.

Exercises and practise in cabinet-making, including paneling, mitre and dove-tail joints; use of power tools.

**114.** Repetition of Course 113. Elective, second semester. Mr. Beem, Mr. Denman, Mr. Smith.

**115. Forging.** Two credit hours. One recitation and two two-hour laboratory periods weekly. Short Industrial Arts, second year, first semester. Ceramic, Chemical, Electrical, Mechanical, and Mine Engineering and Short Clayworking, during the Summer Session at the close of the first year. Mr. Foust, Mr. Wright.

The use and care of forge, fire, and tools. Practise in iron and steel forging, including such operations as cutting, bending, drawing, upsetting, shaping, and welding iron; the making, hardening, and tempering of steel punches, chisels, and lathe tools.

**116.** Repetition of Course 115. Short Mining, first year, second semester. Mr. Foust, Mr. Wright.

**118. Advanced Forging.** Two credit hours. Two three-hour laboratory periods weekly. Elective, second semester. Prerequisite, Shopwork 115. Mr. Foust, Mr. Wright.

Various forms of welds in iron and steel; the use of scrolling irons and of forms for duplicating work; annealing; tool-making, (case-hardening; tempering drills, dies, and cutters; spring-making); ornamental iron work; visits to shops.

**119. Machine Work.** Three credit hours. One recitation and two three-hour laboratory periods weekly. Electrical Engineering and Short Industrial Arts, second year. Mr. Knight, Mr. Case.

Elementary exercises on the engine lathe, such as plain, straight, and taper turning, screw cutting, chucking, boring, filing, and polishing, and the use of the drill press.

**120.** Repetition of Course 119. Mechanical Engineering, second year, second semester. Mr. Knight, Mr. Case.

**121. Advanced Machine Work.** Three credit hours. One recitation and two three-hour laboratory periods weekly. Mechanical Engineering, third year, first semester. Prerequisite, Shopwork 119 or 120. Mr. Knight, Mr. Case.

A continuation of Course 119 or 120 with more difficult exercises on the lathe, including square thread cutting, drilling, and tapping, use of steady rest, face-plate work, and bar turning. Also practise on the milling machines, planer, shaper, and turret lathe.

**122.** Repetition of Course 121. Electrical Engineering and Short Industrial Arts, second year, second semester. Mr. Knight, Mr. Case.

**123. Advanced Machine Work.** Two credit hours. Two three-hour laboratory periods weekly. Elective, first semester. Prerequisite, Shopwork 121 or 122. Mr. Knight, Mr. Case.

A more advanced course in milling machine work and grinding, Exercises in spur and spiral gear cutting, cam cutting, and differential and fractional indexing.

**125. Construction Work.** Two credit hours. First semester. Two three-hour laboratory periods weekly. Elective. Prerequisite, Shopwork 121 or 122. Mr. Knight, Mr. Case.

A course in construction work on any piece of apparatus or machinery which may be in course of construction in the shops.

**126.** Repetition of Course 125. Second semester. Elective. Mr. Knight, Mr. Case.

**127. Tool-Making and Jig Work.** Three credit hours. First semester. Elective. Prerequisite, Shopwork 123. Mr. Knight, Mr. Case.

**128.** Repetition of Course 127. Three credit hours. Elective, second semester. Mr. Knight, Mr. Case.

### FOR GRADUATES ONLY

For a complete description of the graduate work, the bulletin of the Graduate School should be consulted.

**201-202. Research Work.** Five to ten credit hours. The year. Library, conference, and laboratory work. Time to be arranged with the instructor. Prerequisites, Physics 113, 114; Mechanics 101, 102; Mechanical Engineering 127, 144, or Metallurgy 109,110; and the permission of the instructor in charge.

Research work with special reference to the application of Physics, Chemistry, Metallurgy, and Machine Design to the problems of the metal-working industries. This work is under the supervision of Mr. Sanborn and Mr. Knight.

## MATHEMATICS

Office, Room 314, University Hall

PROFESSORS BOHANNAN, MCCOARD, SWARTZEL, KUHN, AND RASOR, ASSOCIATE PROFESSOR ARNOLD, ASSISTANT PROFESSORS PRESTON, BAREIS, MORRIS, WEST, MISS RICKARD.

**101. Elementary Algebra.** Five credit hours. Five recitations weekly. Short Clayworking, Short Industrial Arts, and Short Mining, first year, first semester. Text-book, Wentworth's Algebra.

**102.** Continuation of Course 101. Five credit hours. Five recitations weekly. Short Clayworking, Short Industrial Arts, and Short Mining, first year, second semester. Prerequisite, Mathematics 101.

**113. Plane and Solid Geometry.** Five credit hours. Five recitations weekly. Short Clayworking, Short Industrial Arts, and Short Mining, first year, first semester. Text-book, Wells' New Geometry (1911).

**114. Solid Geometry and Plane Trigonometry.** Five credit hours. Five recitations weekly. Short Clay-working, Short Industrial Arts, and Short Mining, first year, second semester. Prerequisite, Mathematics 113. Text-books: Wells' New Geometry, and Taylor's Trigonometry.

**131. Trigonometry and College Algebra.** Five credit hours. Five recitations weekly. All four-year courses in Engineering, first year, first semester. Prerequisites, Entrance Algebra and Geometry. Text-books: Bohannan's Trigonometry, Rietz and Crathorne's College Algebra.

This course is also given in the second semester.

**132. Analytical Geometry and College Algebra.** Five credit hours. Five recitations weekly. All four-year courses in Engineering, first year, second semester. Prerequisite, Mathematics 131. Text-books: Candy's Analytical Geometry, Rietz and Crathorne's College Algebra.

This course is also given in the first semester and repeated in the Summer Session.

**141. Calculus.** Five credit hours. Five recitations weekly. All four-year courses in Engineering, second year, first semester. Prerequisite, Mathematics 132.

This course is also given in the second semester.

**142.** Continuation of Course 141. Five credit hours. Five recitations weekly. All four-year courses in Engineering, second year, second semester. Prerequisite, Mathematics 141.

This course is also given in the first semester and repeated in the Summer Session.

**151. Differential Equations.** One credit hour. One recitation weekly. Mechanical Engineering, third year, first semester. Prerequisite, Mathematics 142. Text-book: Boyd's Differential Equations.

## FOR ADVANCED UNDERGRADUATES AND GRADUATES

Prerequisite: Differential and Integral Calculus.

**163-164. Plane and Solid Analytical Geometry.** Three credit hours. The year. Mr. Morris.

**167-168. Differential Equations.** Three credit hours. The year. Mr. Rasor.

**173-174. Modern Higher Algebra.** Three credit hours. The year. Mr. Kuhn.

### FOR GRADUATES

**201-202.** (d) **Theory of Functions of a Complex Variable.** Three credit hours. The year. Mr. Bohannan.

**201.** (g) **Fourier's Series and Spherical Harmonics.** Three credit hours. First semester. Mr. Swartzel.

**202.** (v) **Vector Analysis and its Applications.** Three credit hours. Second semester. Mr. Swartzel.

## MECHANICAL ENGINEERING

Office, Room 244, Robinson Laboratory

PROFESSORS MAGRUDER AND MARQUIS, ASSOCIATE PROFESSOR JUDD, MR. BROWN, MR. NEILAN, MR. TARBOX.

### EQUIPMENT

The Department of Mechanical Engineering occupies the south end of the Robinson Laboratory. The main laboratory is 90 feet by 112 feet, and is divided into three sections, The steam-engineering section contains three 35-horsepower horizontal, plain or automatic cut-off engines; one 60-horsepower tandem, compound, horizontal, automatic cut-off engine; one 10-horsepower two-cylinder, single-acting engine; one 30-horsepower tandem, compound, vertical engine with riding cut-offs and link motions; one 250-horsepower cross compound vertical engine, with reheater, direct connected to a 20-inch centrifugal pump of 14,000 gallons per minute capacity; one 60-horsepower simple Corliss engine; one 15-horsepower vertical engine; and one 3-horsepower square-piston engine. Most of the above are arranged to be worked as condensing engines if desired, and are provided with surface condensers, air and circulating pumps, etc. The hydraulic section is equipped with eleven cisterns, a flume having a cross-section of thirteen square feet, submerged orifices up to thirty inches in diameter, a 30-foot well, and weirs capable of measuring up to 16,000 gallons per minute. It is provided with simple, compound, triplex, centrifugal, and rotary pumps, steam-turbine-driven centrifugal pump, pulsometer, turbine and impulse water-wheels, and a variety of apparatus specially adapted to study the flow of liquids. The third section contains Riehle and Olsen testing machines for materials in tension, compression, bending, shear, and torsion; dynamometers for measuring the power supplied to machines; ventilating fans, and the departmental machine shop. Supported by the columns carrying the sawtooth roof, and between the sections, are two galleries each 8 feet by 108 feet. One of them is used as a drawing room; the other is used to study the flow of steam, air, and water through pipes and bends.

Next to the steam laboratory is a section, 48 feet by 144 feet, adapted for the operation and testing of steam boilers and gas-power machinery. The boiler laboratory is equipped with a horizontal, internally-fired tubular boiler; an externally-fired horizontal, return-tubular boiler with brick setting; a locomotive boiler; a house-heating boiler; and a 107-horsepower Babcock and Wilcox watertube boiler, provided with both an automatic stoker and a Dutch-oven furnace having shaking grates, and with forced, induced, and chimney drafts, a Foster independently-fired superheater, and a complete equipment of testing appliances. The gas-engine laboratory has three oil engines and three gas engines of 6-horsepower; one 25-horse power, two-cycle, and one 80-horsepower tandem, four-cycle, horizontal engine, each operated with either natural gas or producer gas; one 75-horsepower suction gas-producer for use with either anthracite, or bituminous coals, with complete facilities for measuring the fuel, air, and water which are used and the power developed.

Between the boilerroom and the electrical engineering laboratory is the demonstration amphitheater and lecture room. In the rear of the amphitheater is a laboratory which is intended for the testing of locomotive machinery, and is connected by rail with the main tracks of the Hocking Valley Railroad, but which is as yet only partially equipped.

The two-story portion at the south end of the building is used for offices, three class rooms, an engineering museum, locker rooms, oil-testing laboratory, photographic dark-room, and instrument room.

## SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**101. Mechanism.** Three credit hours. Three recitations weekly. Electrical Engineering, third year, first semester. Prerequisites, Engineering Drawing 103, Physics 114. Mr. Sanborn.

Recitations on the principles of mechanism and mechanical movements.

**103. Steam Power Plants.** Three credit hours. Three recitations weekly. Chemical, Electrical, and Mechanical Engineering, third year, first semester. Prerequisites, Engineering Drawing 104, Physics 112. Mr. Marquis, Mr. Brown.

A descriptive study of steam-generating and steam-using machinery.

**110. Mechanism and Machine Design.** Three credit hours. Three recitations weekly. Ceramic Engineering, third year, second semester. Prerequisites, Engineering Drawing 104, Mechanics 101. Mr. Judd.

Recitations on the principles of mechanism, mechanical movements, and elementary machine design.

**114. Mechanism.** Three credit hours. Three recitations weekly. Mechanical Engineering, third year, second semester. Prerequisites, Engineering Drawing 104, Physics 112. Mr. Sanborn.

Recitations and practise on the principles of mechanism and mechanical movements.

**116. Mechanism Drawing.** One credit hour. One three-hour drawing period weekly. Mechanical Engineering, third year, second semester. Prerequisite or concurrent, Mechanical Engineering 114. Mr. Sanborn.

Practise in laying out mechanisms and mechanical movements.

**118. Steam Engines.** Three credit hours. Three recitations weekly. Electrical and Mechanical Engineering, third year, second semester. Prerequisites, Mechanical Engineering 103, Mechanics 101. Mr. Magruder, Mr. Marquis.

**120. Steam Boilers.** One credit hour. One recitation weekly. Mechanical Engineering, third year, second semester. Prerequisites, Mechanical Engineering 103, Mechanics 101. Mr. Marquis.

**121. Heating and Ventilating.** Two credit hours. Two recitations weekly. Architecture, fourth year, first semester. Prerequisite, Mechanics 101. Mr. Marquis.

Recitations and lectures on the principles and methods of heating and ventilation, with laboratory work and investigations of the heating and ventilating plants of different buildings.

**123. Materials of Construction.** Two credit hours. One recitation and one three-hour laboratory period weekly. Architecture, fourth year, first semester. Prerequisite, Mechanics 101. Mr. Judd.

Lectures and recitations on the materials used in architectural and building construction, and laboratory exercises on their properties.

**125. Gas Engines and Producers.** Two credit hours. Two recitations weekly. Required in Mechanical Engineering, fourth year, first semester. Prerequisite, Mechanical Engineering 118. Mr. Magruder.

A study of gas-engines and of gas-producers as used for power purposes.

**127. Machine Design.** Five credit hours. Five recitations weekly. Required in Chemical and Mechanical Engineering, fourth year, first semester. Prerequisites, Engineering Drawing 104 and 111, Mechanics 102, Metallurgy 109, Mechanical Engineering 103. Mr. Magruder, Mr. Sanborn.

A detailed course of study based upon mechanics and the materials of construction applied to the design and construction of machinery.

**129. Thermodynamics.** Two credit hours. Two recitations weekly. Required in Mechanical Engineering, fourth year, first semester. Prerequisite, Mechanical Engineering 118. Mr. Magruder.

The transmutations of heat and mechanical energies in steam and air engines, in air and ammonia compressors, and in refrigeration machines, together with a study of the tests of ideal and actual engines and of their indicator diagrams; the flow of gases through pipes and orifices.

**130. Inspection Trip to the East.** April 26 to May 3, 1914. Required in Mechanical Engineering, third and fourth years. Concurrent, Mechanical Engineering 118. Given only in the even years. Mr. Marquis, Mr. Judd.

Includes Pittsburgh, Buffalo, Niagara Falls, Cleveland, and possibly other places. The entire expense need not exceed $32. A satisfactory written report upon the work of the trip and examination are required.

**132. Inspection Trip to the West.** April 25 to May 2, 1915. Required in Mechanical Engineering, third and fourth years. Concurrent, Mechanical Engineering 118. Given only in odd years. Mr. Marquis, Mr. Judd.

Includes Chicago, Milwaukee, Gary, and possibly other places. The entire cost need not exceed $32. A satisfactory written report upon the work of the trip and examination are required.

**134. Written Report.** Course of assigned reading upon processes of manufacture and power plants taken and reported upon by the third and fourth year students in Mechanical Engineering as a substitute for Mechanical Engineering 130 on presentation of reasons satisfactory to the head of the department. Mr. Magruder.

**136. Written Report.** Similar to Mechanical Engineering 134, as a substitute for Mechanical Engineering 132. Mr. Magruder.

**140. Mechanism and Machine Design**. Two credit hours. Two recitations weekly. Required in Civil Engineering, fourth year, second semester. Prerequisite, Mechanics 102. Mr. Judd.

An elementary course in the principles of mechanism and mechanical movements and the design of parts of machines.

**142. Hydraulic Machinery.** Two credit hours. Two recitations weekly. Required in Mechanical Engineering, fourth year, second semester. Prerequisites, Mechanics 102, Mechanical Engineering 118. Mr. Judd.

A study of pumping machinery.

**144. Machine Design.** Five credit hours. Three recitations and two three-hour drawing periods weekly. Required in Chemical and Mechanical Engineering, fourth year, second semester. Prerequisite, Mechanical Engineering 127. Mr. Magruder and Mr. Sanborn.

A continuation of Course 127, with practical applications on the drawing board of the principles to the design of some particular machine.

**146. Steam Turbines.** Two credit hours. Two recitations weekly. Optional in Mechanical Engineering with Industrial Arts 114, fourth year, second semester. Prerequisite, Mechanical Engineering 129. Mr. Marquis.

A study of the generation of power by steam turbines, including auxiliary machinery.

**148. Thesis Work.** Three credit hours. Required in Mechanical Engineering, fourth year, second semester. Prerequisites, Mechanical Engineering, 125, 127, 129, and 179. Mr. Magruder, Mr. Marquis, Mr. Judd.

A special investigation or design based upon the work of the courses.

**150. Hydraulic Power.** Three credit hours. Two recitations and one three-hour laboratory period weekly. Elective in Civil, Electrical, and Mechanical Engineering; fourth year, second semester. Prerequisite, Mechanical Engineering, 173, 175, or 179. Mr. Judd.

A study of hydraulic turbines and the generation of hydraulic power.

**160. Experimental Engineering Laboratory.** Two credit hours. One four-hour laboratory period weekly. Required in Electrical Engineering, third year, second semester. Concurrent, Mechanics 102. Mechanical Engineering 118. Mr. Marquis, Mr. Judd, Mr. Brown,

Calibration of pressure gages and indicator springs, steam engine indicator practise, testing of lubricating oils, and the materials of construction.

**164. Experimental Engineering Laboratory.** Two credit hours. One four-hour laboratory period weekly. Required in Mechanical Engineering, third year, second semester. Concurrent, Mechanics 102, Mechanical Engineering 118. Mr. Marquis, Mr. Judd, Mr. Brown.

Calibration of pressure gages and indicator springs; steam-engine indicator practise; testing of oils, and the materials of construction.

**173. Experimental Engineering Laboratory.** Five credit hours. One recitation and two four-hour laboratory periods weekly. Required in Civil Engineering, fourth year,first semester. Prerequisite, Mechanics 102. Mr. Marquis, Mr. Judd, Mr. Brown.

Practise in the testing of the materials of construction; calibration of orifices and weirs; study of the flow of liquids and gases; tests of steam, power, rotary, and centrifugal pumps; tests of water motors and turbine water-wheels. Lectures and recitations on same and on steam engines, boilers, and transmission machinery.

**175. Experimental Engineering Laboratory.** Three credit hours. One six-hour laboratory period weekly. Required in Electrical Engineering, fourth year, first semester. Prerequisites, Mechanical Engineering 118 and 160. Mr. Marquis, Mr. Judd, Mr. Brown.

Tests of steam engines and boilers; gas and oil engines; steam and power pumps; hydraulic experimentation; and the use of transmission and absorption dynamometers.

**179. Experimental Engineering Laboratory** Two credit hours. One four-hour laboratory period weekly. Required in Mechanical Engineering, fourth year, first semester. Prerequisite, Mechanical Engineering 164. Concurrent, Mechanical Engineering 125 and 129. Mr. Marquis, Mr. Judd, Mr. Brown.

Valve setting, moisture determinations in steam, gas calorimetry, measurements of flow of water by means of orifices, nozzles, weirs, and venturi-meter; tests of belts with use of transmission and absorption dynamometers.

**190. Experimental Engineering Laboratory.** Six credit hours. Four three-hour laboratory periods weekly. Required in Mechanical Engineering, fourth year, second semester. Prerequisites, Mechanical Engineering 125, 129, and 179. Mr. Marquis, Mr. Judd, Mr. Brown.

Tests of steam and hot-air engines; steam boilers; gas and oil engines; gas producers; air compressors; injectors and pulsometers;

centrifugal, rotary, and power pumps; hydraulic rams, impulse and turbine water wheels; fans and blowers, and steam turbines.

**192. Experimental Engineering Laboratory.** Three credit hours. One recitation and one four-hour laboratory period weekly. Required in Mine Engineering, fourth year, second semester. Prerequisites, Mechanics 102, Metallurgy 109. Mr. Judd, Mr. Brown.

Lectures and recitations on power transmission, steam and gas engines, steam boilers, and gas producers. Laboratory work in the calibration of pressure gages and indicator springs; valve setting; testing of steam engines, testing of steam and centrifugal pumps; boiler aud fuel trials; tests of gas engines and gas producers.

### FOR GRADUATES ONLY

For a complete description of the graduate work, the bulletin of the Graduate School should be consulted.

**201-202. Research Work.** Five to ten credit hours. The year. Library, conference, and laboratory work. Time arranged with the instructor. Prerequisite, the permission of the instructor in charge.

Research work in gas enginery is conducted under the supervision of Mr. Magruder; in steam enginery and fuel testing, under Mr. Marquis; in applied hydraulics, under Mr. Judd.

## MECHANICS

Office, Room 233, Lord Hall

PROFESSOR J. E. BOYD, PROFESSOR CODDINGTON, MR. BRUBAKER

### EQUIPMENT

The Department of Mechanics occupies rooms in the Mines Building. The equipment consists of apparatus for a limited number of class room experiments designed to illustrate the fundamental facts of the science. It includes pulleys, platform scales, spring balances, a three-foot graduated circle for resolution of forces, apparatus for demonstrating couples in parallel planes, a chain for catenary experiments, model for shear and moment in beams, and apparatus for measuring acceleration and accelerating force.

The Department has a set of special extensometers for determining the maximum stress in bridge columns, and a second set for photographically recording the stresses due to moving trains. These are used jointly with the Department of Civil Engineering in thesis investigations.

The laboratory work in strength of materials, involving the use of testing machines, is given at present in the Department of Mechanical Engineering.

### SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**101. Statics and Strength of Materials.** Five credit hours. Architecture, Ceramic, Chemical, Civil, Electrical, Mechanical, and Mine Engineering, third year, first semester. Prerequisite, Mathematics 142.

**102. Strength of Materials, continued, Kinetics and Hydraulics.** Five credit hours. Chemical, Civil, Electrical, Mechanical, and Mine Engineering, third year, second semester. Prerequisite, Mechanics 101.

**104. Strength of Materials.** Two credit hours. Architecture and Ceramic Engineering, third year, second semester. Prerequisite, Mechanics 101.

### FOR GRADUATES ONLY

For a complete description of graduate work, the bulletin of the Graduate School should be consulted.

**201-202. Advanced Theoretical Mechanics.** Three credit hours. The year.

Library and Conference work. Time to be arranged with the instructor. Perequisite, Mechanics 101-102, and the permission of the instructor in charge. This work is done under the supervision of Mr. Boyd and Mr. Coddington.

## METALLURGY

Office, Room 100, Lord Hall

PROFESSORS SOMERMEIER AND DEMOREST

### EQUIPMENT

The equipment of this department is unusually complete. It occupies about 14,000 square feet of floor space at the east end of the basement and first floor of Lord Hall. In addition to the lecture rooms, there are separate laboratories for the following lines of work: for the analysis and assaying of iron, steel, ores, and furnace products by wet methods; for fire assaying and testing of gold and silver ores, equipped with furnaces and cyanide plant; for general and determinative mineralogy, equipped for blowpipe analysis and for the microscopic examination of minerals; for the calorimetric examination of coals and other fuels, technical gas analysis, and the examination of mine air; for the microscopic examination and thermal tests of metals; and for the analysis and complete examination of coals. There is also a crushing and sampling plant for experimental tests on ores and minerals. The department now has a complete model New Century coal jig, a small experimental ore jig, and other apparatus for the practical testing of coal and ores by washing methods. The museum contains a large number of specimens and is being constantly developed.

## SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**102. Mineral Chemistry.** Four credit hours. Short Mining, second year, second semester. Prerequisite, Chemistry 101. Mr. Demorest, Mr. Minor.

A course of lectures upon mine gases, safety lamps, mine explosions, boiler water, mine water, water supply, explosives, coal, and coke.

**105. Fire Assaying.** Three credit hours. Mine Engineering, third year, first semester. Laboratory, two afternoons per week, Monday and Tuesday, or Thursday and Friday. Prerequisite, Metallurgy 106, or equivalent. Mr. McCaughey.

Lectures and laboratory work. Practical work in the assaying of gold, silver, and lead ores.

**106. Metallurgical Analysis.** Four credit hours. One lecture, nine hours laboratory weekly. Mine Engineering, second year, second semester. Prerequisite, Chemistry 106 or 110, Chemistry 119. Mr. Demorest.

Lectures and laboratory work. Laboratory work in the analysis of iron ores, iron and steel, fuel and slags, and ores of lead, zinc, and copper by wet methods, using approved methods as practised in technical laboratories and metallurgical works.

**107. Alloy Analysis.** Four credit hours. One lecture, nine hours laboratory weekly. Mine Engineering, third year, first semester. Prerequisite, Metallurgy 106. Mr. Demorest.

Lectures and laboratory work. Laboratory work in the analysis of alloy steels, such as vanadium, tungsten, chromium, nickel, and molybdenum steels, and other alloys. Quantitative work preceded by qualitative tests on the alloys.

**109. General Metallurgy.** Four credit hours. Mine Engineering, Mechanical Engineering, Chemical Engineering, third year, first semester. Ceramic Engineering, fourth year, first semester. Prerequisites, Chemistry 106, Physics 114. Mr. Somermeier, Mr. Demorest.

Lectures and recitations on general metallurgy, fuels, iron and steel, their properties and manufacture.

**110. Metallurgy of Non-Ferrous Metals.** Four credit hours. Mine Engineering, third semester. Mr. Somermeier.

Lectures and recitations on the metallurgy of the non-ferrous metals; copper, lead, gold, silver, etc. Their properties, reduction, and purification.

**111. Metallurgical Construction.** Two credit hours. Mine Engineering, fourth year, first semester. Prerequisites, Drawing 111, Mechanics 102, Metallurgy 109 and 113. Mr. Somermeier, Mr. Minor.

Lectures and drawing room practise on the designing of furnaces and metallurgical plants.

**112. Technical Gas Analysis.** Two credit hours. Mine Engineering, third year, second semester. Two afternoons per week. Prerequisites, Metallurgy 106, 109, or equivalent. Mr. Demorest.

Laboratory work supplemented by lectures. Technical analysis of metallurgical and mine gases. Determination of the calorific value of gases; problems involving application of results of gas analysis to furnace operation, mine ventilation, etc.

**113. Ore Dressing and Coal Washing.** Two credit hours. Mine Engineering, fourth year, first semester. Prerequisite, Metallurgy 109. Mr. McCaughey.

Methods of concentrating and enriching ores and fuels by mechanical means. Lectures with references to standard books and various papers in technical journals.

**114. Special Metallurgy.** Three credit hours. Mine Engineering, fourth year, second semester. Hours to be arranged. Prerequisites, Metallurgy 106, 107, 109, 110, or equivalent. Mr. Somermeier.

Lectures and laboratory, supplemented by lectures on microscopic examination of metals, study of properties of alloys, testing of metallurgical processes, pyrometry, and high temperature measurements, calorimetry, and other tests on fuels.

**116. Thesis.** Three credit hours. Second semester.

### FOR GRADUATES ONLY

For a complete description of the graduate work, the bulletin of the Graduate School should be consulted.

**201. Research Work.** Three to five credit hours. First semester. Library, conference and laboratory work. Time arranged with the instructor. Prerequisite, the permission of the instructor in charge. These courses are under the supervision of Mr. Somermeir and Mr. Demorest.

(a) **Iron, Steel, and other Alloys.** Investigations on the composition, properties, structure, and heat treatment. Prerequisite, Metallurgy 114.

(b) **Fuels.** Investigations on composition, conservation, and utilization. Prerequisite, Metallurgy 114.

(c) **Investigations on the Metallurgy and Analysis of the Less Common Metals,** as tin, antimony, bismuth, tungsten, etc. Prerequisites, Metallurgy 106 and 109.

(d) **Investigation of Special Metallurgical Processes**, as the electrolytic refining of lead, etc. Prerequisites, Metallurgy 106 and 109.

## MILITARY SCIENCE AND TACTICS

Office, The Armory

CAPTAIN GEORGE L. CONVERSE, U. S. A., RETIRED

In accordance with the Morrill Act, passed in 1865, under which the University was established, military instruction must be included in the curriculum. The Board of Trustees therefore requires all (this includes special as well as regular students), male students, *unless excused by the Military and Gymnasium Board*, to drill during two years. The work is under an officer of the regular army, detailed for the purpose. The Military Department is open during five days each week throughout the year.

### EQUIPMENT

The equipment of the Military Department comprises 1300 standard U. S. magazine rifles, with belts, bayonets, and accoutrements, 51 regulation infantry officers' sabers and belts, 25 cadet swords and belts, a stand of regimental colors, with markers, guidons, etc. The target practise equipment comprises 6 Springfield gallery rifles and 7 Winder model Winchester gallery rifles, 5 targets for 100, 200, and 300 yards, and 5 Winder-model targets for long range. The band comprises about 60 pieces, partly supplied by the University and partly owned by the members.

The office is equipped for recording the attendance and performance of each cadet in drill, target practise, and class-room work.

## ORGANIZATION

The cadet regiment is organized into four battalions of four companies each, a band, and a trumpet corps. Each battalion has its own staff officers. The total number of men under arms averages about one thousand at present. Service in the band is credited as military service. The appointment of cadet officers during the second year of service is for excellence in their work. These officers may continue to serve during the third and fourth years if they wish, and if they do, are given compensation at the end of each year's satisfactory service amounting to not less than $25.00 for lieutenants, $30.00 for captains, and larger sums for officers of higher ranks. Members of the band who volunteer for service after having completed their two years required duty are also paid at the rate of $20.00 per year, and receive instruction during the four winter months from a competent band-master.

## SUBJECTS IN WHICH INSTRUCTION IS OFFERED

1. **Military Drill.** One credit hour. Five months, three hours per week (divided between fall and spring) military drill; four months three hours per week, (winter) of class-room instruction in drill regulations. Target practise at any open hour during the afternoons of the winter months, at 100, 200, and 300 yards. Lecture, one hour weekly, by the President, upon topics of common interest to the student body.

2. **Military Drill.** One credit hour. Five months, three hours per week, (divided between fall and spring) in extended order and guard duty. Four months, three hours per week (winter) of class-room instruction in Articles of War, guard manual and field service, regulations. Target practise, at any open hour of the afternoons of the winter months, at 500, 600, and 800 yards.

**Note**—New students entering the University are cautioned not to buy uniforms until so instructed by the Commandant. Second-hand uniforms are rarely accepted.

# MINE ENGINEERING

Office, Room 200, Lord Hall

PROFESSOR RAY, ASSISTANT PROFESSOR MINOR

## EQUIPMENT

The department occupies the east end of the second floor of the School of Mines Building and one basement room, and has a floor space of 6000 square feet. This includes the office of the department, a large lecture room, a drawing room with accommodations for fifty students, a blue-print room with full equipment for both sun and electric light printing, a laboratory for safety lamp testing and other special work, and in the basement a large room for work in ventilation.

The equipment includes all of the latest improved instruments and apparatus used in mine surveying and mine ventilation. There is a variety of surveying instruments for general practise, also targets, plummet lamps, etc., for mine and tunnel work. The laboratory contains apparatus for the testing and an outfit for the repair of safety lamps; and practise tests are made with the lamps for the detection and estimation of fire damp. An outfit for special analytical, chemical, and mineralogical work is also available for use at all times. A growing collection of models of mines, smelters, ore dressing plants, coal tipples, metal head frames, split construction and the various types of framing are used in connection with the lectures and are kept in the museum for the use of the students. For the practical study of ventilation the equipment is complete, and includes anemometers, water gages, barometers, barographs, polymeters, registers, etc., some of which are self-recording; there are also a portable gas apparatus and various forms of rescue apparatus.

## SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**101. Mine Engineering.** Five credit hours. Lectures and field practise. Short Course in Mining, second year, first semester. Prerequisite, Mathematics 114. This course is similar to Course 103, but more elementary. The same text is used. The students have more practise in the drawing room. Mr. Minor.

**102. Mine Engineering.** Five credit hours. Short Course in Mining, second year, second semester. Prerequisites, Mine Engineering 101, Physics 101. Lectures illutsrated by experiments, and maps of mines and models when possible; tests by safety lamps and anemometers; methods of air distribution in coal mines. Mr. Minor.

**103. Mine Engineering.** Mine Surveying. Four credit hours. Mine Engineering, second year, first semester; Ceramic Engineering, third year, first semester. Prerequisites, Engineering Drawing 104, Mathematics 132. Field practise in the use of instruments for surface and underground surveys. Field notes are taken and maps and plans made in the drawing room. Mr. Ray, Mr. Minor.

**104. Mine Engineering.** Plans and Specifications. Four credit hours. Mine Engineering, fourth year, second semester. Prerequisite, Mine Engineering 105, Metallurgy 111. Practise in designing mine plants, drafting, and estimating. Mr. Ray, Mr. Minor.

**105. Mine Engineering.** Five credit hours. Mine Engineering, fourth year, first semester. Prerequisites, Mechanics 102, Mine Engineering 103, Geology 165. Lectures on mine operating, mining machinery, ventilation, shaft sinking, working out deposits, etc. Constant reference is required to standard works and to the leading technical journals. Mr. Ray.

**106. Mine Engineering.** Five credit hours. Mine Engineering, fourth year, second semester. Prerequisite, Mine Engineering 105. A continuation of Mine Engineering 105. Mr. Ray.

**107. Mine Engineering.** Two credit hours. Two two-hour drawing periods weekly. Short Mining, second year, first semester. Mine Engineering 101, concurrent. Mr. Minor.

**109. Mine Trip.** One credit hour. First semester. Mr. Minor.

**110. Mine Trip.** One credit hour. Second semester. Mr. Minor.

**116. Thesis.** Three credit hours. Second semester. Mr. Ray, Mr. Minor.

## FOR GRADUATES ONLY

For a complete description of the graduate work, the bulletin of the Graduate School should be consulted.

**201-202. Research Work.** Three to five credit hours. The year. Library, conference, laboratory, and field work. Time arranged with the instructor. Prerequisite, the permission of the instructor in charge.

Mine accidents; preventive regulations; statutory provisions; mine fires; mine explosions; gas indicators; rescue operations; rescue appliances. This work is under the supervision of Mr. Ray and Mr. Minor.

# MINERALOGY

Room 104, Lord Hall.

ASSISTANT PROFESSOR McCAUGHEY.

**102. Crystallography and Mineralogy.** Three credit hours. Mine Engineering, second year; Chemical Engineering, third year, second semester; Pharmacy, fourth year, second semester. Prerequisite, Chemistry 106 or 110.

Lectures on Crystallography, Physical and Descriptive Mineralogy. Illustrated by drawings, models, and mineral specimens.

**104. Determinative Mineralogy.** Three credit hours. One lecture, two three-hour laboratory periods weekly. Mine Engineering, third year. Second semester. Prerequisite, Mineralogy 102.

Lectures and laboratory work in practical determination of minerals by physical and chemical tests. Each student is furnished with a set of apparatus and works under an instructor's inspection. Brush and Penfield's "Determinative Mineralogy" is used as a manual.

**121. Microscopic Mineralogy.** Three credit hours. First semester. One lecture and two laboratory periods. Prerequisite, Mineralogy 102 and Physics 114.

The use of the polarizing microscope in the identification of minerals in fine powder and in thin section. Determination of the optical constants of minerals and crystallized bodies with the polarizing microscope.

**124. Microscopic Petrography**. Three credit hours. Prerequisites, Geology 165, 166, Mineralogy 102, 121.

The study of igneous and metamorphic rocks, especially their mineralogical and chemical composition, also their textural and genetic relations. Laboratory work with petrographic microscope and thin section of rocks.

**126. Advanced Crystallography and Physical Mineralogy.** Three credit hours. Second semester. Two lectures and one laboratory period. Prerequisites, Physics 114, Mineralogy 102.

The study of the geometrical and physical properties of crystals. Laboratory work on the measurement, calculation, and projection of crystals and the determination of the physical and optical constants of crystallized bodies.

## PHYSICAL EDUCATION

DR. H. SHINDLE WINGERT, DIRECTOR

Office, Gymnasium

**Physical Education** for men and women is conducted under the direct supervision of the Professor of Physical Education, who is a medical graduate. For the men's work he has two Assistants, and twenty student aids who are selected each year from those who show proficiency in their work. For women there is an Associate Professor, who is also a medical graduate, an Instructor, and one paid student Assistant.

**Aim of the Department.** (a) To develop and maintain the health and human efficiency of the student. (b) To extend physical education and hygiene throughout the community and State. (c) To train teachers and leaders in these subjects.

**Equipment.** The Armory and Gymnasium (175 x 120 feet) is used jointly by the Departments of Military Science and Physical Education, also during the winter months by the Department of Athletics. On the ground floor are the officers' rooms, aids' room, locker room, baths, swimming pool, and a large room (50 x 80 feet) which is used as a gymnasium for the men in the mornings, and for target practice by the Military Department in the afternoons. The second floor contains administrative offices and the main floor of the gymnasium (80 x 150 feet). The gymnasium contains a first-class equipment of modern gymnasium apparatus, including a running-track 13½ laps to the mile. The women's section occupies the ground floor of the east end of the building, and contains offices, dressing and locker rooms, baths, and swimming pool. The main floor of the gymnasium is used by the women in the forenoon. In the afternoon, the main floor is used exclusively by the men for class work, athletics, basket-ball, and recreative games. The gymnasium is open on alternate evenings to men and women, and for athletic games and contests.

**Play Ground.** The south end of the campus, containing over 30 acres, affords ample space for all out-door recreative games and sports. All the work of this department that can be conducted out doors, with benefit to the student, is given on these grounds.

**Medical and Physical Examination.** A thorough medical and physical examination is required of all first-year students, at the opening of the Freshman year; this includes examination of heart, lungs, eyes, nose, ears, throat, and teeth; blood pressure, and urinalysis when indicated; a limited number of essential measurements of the body; (and certain strength-tests for men).

When weaknesses or abnormal deviations of form, structure, or function are discovered, suitable corrective exercises, recreation, or treatment is prescribed.

Students found suffering from organic disease are excused from exercises that might prove injurious, and required to secure proper medical advice and treatment.

## (A) FOR MEN

PROFESSOR WINGERT, MR. OHLSON, MR. BARTHOLOMEW

1. **Physical Education.** One credit hour. Two hours per week, the year. Required of all first-year students in this college. During the first semester the course consists of one lecture on Personal Hygiene and one period of active physical exercises each week.

(a). Personal Hygiene. Lectures and quizzes on the cause, prevention, and hygiene treatment of the common preventable diseases and conditions which lower the vitality and interfere with the health and efficiency of the student. Hygiene of the respiratory tract, "colds", and minor diseases of the nose, throat, and tonsils, and tuberculosis. The digestive tract, food values, indigestion, constipation, etc., hydropathy, bathing, etc., hygiene of the eye, eye-strain, venereal diseases, ventilation, clothing, and the principles of rational work, rest, recreation, nutrition, etc.

(b). Physical exercises in class. *Corrective*; a graded course of free-hand exercises, stretching, relaxing, stimulating exercises, with light hand apparatus for the relief and correction of slight bodily defects, improper carriage, etc. *Educative*; graded, progressive exercises on the apparatus and mats, to promote muscular tone, organic vigor, bodily skill, etc. *Recreative*; dancing, gymnastic and athletic games and contests, giving mental rest, relaxation, and diversion.

(c). During the second semester, two hours a week of active exercise in class is required. An effort is made to develop a "habit of exercise", and those games, sports, and exercises which the student is most likely to follow in the after-college years are encouraged—such as all legitimate types of class and social dancing, swimming, (every man must learn to swim), tennis, club-swinging, fencing, volley ball, and the various group games and contests outdoor and indoor.

### MEDICAL EMERGENCY SECTION

(In the Gymnasium)

This department maintains a medical emergency section, open to all students, male or female, in the department. Emergency medical advice and treatment is furnished free to students while on the campus, during regular University hours.

## (B) FOR WOMEN

Office, The Gymnasium

DR. GOETZ, MISS SAUER, MISS COURTNEY

**1. Physical Education.** One credit hour. Four hours per week. Required of all women students during first year of attendance at the University.

(a) Lectures on Personal Hygiene; two hours per week for first eight weeks of first or second semester.

(b) Gymnasium exercises, elementary Swedish gymnastics, calisthenics, drills with wands, Indian clubs, etc. Folk dancing, technique of aesthetic dancing, and gymnastic games. Two hours per week for first eight weeks, then four hours per week.

(c) (Elective.) Recreative games and sports, tennis, basketball, hiking, swimming, when conducted under proper supervision; may be elected for gymnasium exercises. Hours to be arranged.

**2. Physical Education.** For second year students; required of all women students after completing course.

(a) Lectures on Principles of Physical Education, one hour per week, first eight weeks of first semester.

(b) Gymnasium exercises: marching, tactics, calisthenics, series of exercises with wands, clubs, etc., requiring more skill in execution than those in Course 1, folk dancing and gymnastic games, and elementary exercises on apparatus suitable for women.

(c) Recreative games and sports, same as 1 (c).

# PHYSICS

Office, Room 24, Physics Building

PROFESSORS COLE, EARHART, BLAKE, AND BARNETT, ASSISTANT PROFESSORS SHEARD AND SMITH, MR. HEIL, MR. ALVA SMITH, AND DEPARTMENT FELLOWS

## EQUIPMENT

This science, upon the principles of which so much of the work of all classes of engineers is based, is well housed in the Physics Building. A lecture room, capable of seating 250 students, and with fine equipment, is used for the lectures of the second year. This course also includes recitations and laboratory work. The equipment for the latter permits each student to perform experiments illustrating the work covered in class. For the special laboratory work in mechanics and heat the equipment is good, including apparatus for showing the composition of forces, acceleration of gravity, balances, chronometers, chronographs, cathetometers, calorimeters, and various other forms of heat apparatus. In electricity and magnetism, upon which the work of the electrical engineering course so largely depends, the equipment is unusually complete, including, besides the necessary galvanometers, resistance boxes, voltmeters, ammeters, wattmeters, etc., many special instruments such as oscillographs, potentiometers, photometric apparatus, and watt-hour meters. The laboratories for this work are located in the basement and are liberally provided with slate-capped brick piers and wall brackets which give excellent conditions for the use of galvanometers. The laboratories are thoroughly wired, and a large storage battery, as well as a motor generator set and mercury vapor converter, furnishes current.

## SUBJECTS IN WHICH INSTRUCTION IS OFFERED

**101. Elementary Physics.** Six credit hours. Five recitations and lectures, one three-hour laboratory period weekly. Short Clayworking, second year, first semester. Short Mining, first year, first semester. Text-book, Millikan and Gale's Elements of Physics. Mr. Heil.

**111. General Physics.** Three credit hours. Two lectures, one recitation, and one two-hour laboratory period weekly. Architecture, Chemical, Civil, Ceramic, and Mine Engineering, second year, first semester. Prerequisites, Preparatory Physics and Mathematics 132. All instructors. Lectures by Mr. Cole.

**112**. Continuation of Physics 111. Three credit hours. Two lectures, one quiz, and one two-hour laboratory period weekly. Ceramic, Chemical, Civil, Mine, and Mechanical Engineering. Prerequisite, Physics 111. All instructors. Lectures by Mr. Cole.

**113**. **General Physics**. Mechanics and Heat. Five credit hours. Two lectures, three recitations, and one two-hour laboratory period weekly. Electrical and Mechanical Engineering, second year, first semester. Prerequisites, Preparatory Physics and Mathematics 132. All instructors. Lectures by Mr. Cole.

**114**. **General Physics**. Electricity, Light, and Sound. A continuation of Physics 113. Five credit hours. Two lectures, three recitations, and one two-hour laboratory period weekly. Electrical Engineering, second year, second semester. Prerequisite, Physics 113. All instructors. Lectures by Mr. Cole.

**133**. **Physical Laboratory**. Two credit hours. Two two-hour laboratory periods weekly. Electrical Engineering, second year, first semester. Concurrent, Physics 113. Mr. Smith, Mr. Heil.

**134**. **Electrical Measurements and Photometry**. Three credit hours. Two three-hour laboratory periods weekly. Electrical Engineering, second year, second semester. Concurrent, Physics 114, Mathematics 142. Mr. Barnett, Mr. Alva Smith.

**135**. **Electrical Measurements and Photometry**. Five credit hours. Three three-hour laboratory periods weekly. A continuation of Physics 134. Electrical Engineering, third year first semester. Prerequisites, Physics 114 and 134, Mathematics 141-142. Mr. Barnett. Mr. Alva Smith.

**137**. **Physical Laboratory**. Three to five credit hours. Prerequisite or concurrent, Physics 111. Elective.

**138**. **Physical Laboratory**. Two credit hours. Two two-hour laboratory periods weekly. Mechanical Engineering, second year, second semester. Prerequisite, Physics 111; concurrent, Physics 112. Elective, three to five credit hours. Mr. Smith. Mr. Heil.

**139-140**. **Advanced Electrical Measurements.** Three to five credit hours. The course may be elected either semester. Prerequisite, Physics 135 or equivalent. Mr. Barnett.

This course is subject to considerable variation to meet the needs of individual students, but a large amount of time is always devoted to oscillograph work.

### FOR GRADUATES AND ADVANCED UNDERGRADUATES

For a complete description of the graduate work, the bulletin of the Graduate School should be consulted.

**123-124. Advanced Laboratory.** Three to five credit hours. The year. Prerequisite, Physics 121-122. Mr. Cole.

***144. Electricity.** Three credit hours, second semester. Prerequisite, Physics 103-104 or 105-106; calculus precedes or accompanies. Mr. Earhart.

### FOR GRADUATES ONLY

**203-204. Theoretical Mechanics.** Three credit hours. The year. Prerequisites, Physics 105-106, Mathematics 141-142, or equivalents. Mr. Blake.

***205-206. Thermodynamics and Electrolytic Conduction.** Two credit hours. The year. Prerequisites, Physics 105-106, Mathematics 141-142, or equivalents. Mr. Smith.

**207-208. Theory of Electricity and Magnetism.** Three credit hours. The year. Prerequisites, Physics 105-106, Mathematics 141-142, or equivalents. Mr. Smith.

**211-212. Theory of Oscillations with Applications to Wireless Telegraphy.** Two credit hours. The year. Prerequisites, Physics 105-106, Mathematics 141-142, or equivalents. Alternates with 213-214. Mr. Blake.

**215-216. Electromagnetic Theory.** Three credit hours. The year. Mr. Barnett.

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*Not given in 1914-15.

## ROMANCE LANGUAGES AND LITERATURES

Office, Room 305, University Hall

PROFESSORS BOWEN, BRUCE, AND INGRAHAM, ASSISTANT PROFESSORS HAMILTON AND CHAPIN, MR. BOND, MR. DUNHAM, MR. DITCHY, MR. MOORE

### I. FRENCH

**101-102. Elementary French.** Four credit hours. The year. Four recitations weekly, first year. May be taken by students in any four-year course who enter with no entrance credits in French. Text-books: Fraser and Squair's Grammar or equivalent and Aldrich and Foster's or Bowen's First Scientific Reader. Followed by historical and narrative prose; one or more prose comedies.

**103. Modern French Literature.** Four credit hours. Four recitations weekly, first year, first semester. May be taken by first year students in any four-year course who enter with two units entrance credits in French. Prerequisite, French 101-102, or two units entrance credits.

Nineteenth Century Prose, including (1) contes, (2) the novel (Balzac or Hugo). Prose composition, with practise in speaking. Systematic attention given to syntax and idiom.

**106. Science Reading.** Four credit hours. Four recitations weekly, first year, second semester. Must be taken by students in Engineering who take French 103 during the first semester.

A course of rapid reading introductory to the vocabulary of scientific literature.

### II. SPANISH

**101-102. Elementary Spanish.** Four credit hours. The year. Four recitations weekly, first year. May be taken by students in any four-year course who enter with no entrance credits in Spanish. Textbooks: Ingraham-Edgren's Grammar, or equivalent, and Ingraham's Victoria y Otros Cuentos. Easy prose and plays. Composition and practise in speaking.

**103-104. Modern Spanish Literature.** Four credit hours. The year. Four recitations weekly. May be taken by students who enter with two units entrance credits in Spanish. Prerequisite, Spanish 101-102, or two units entrance credits.

The novel and drama of the nineteenth century. Lectures covering a survey of the literature. Composition and practise in speaking continued.

## SHOPWORK

(See Industrial Arts)

## SPANISH

(See Romance Languages)

## ENROLMENT

November 1, 1913.

| | |
|---|---|
| **Students in Four-Year Courses Leading to Degrees** | 851 |
| **Students in Short Courses not Leading to Degrees** | 19 |
| **Special Students** | 6 |
| **Total** | 876 |

### Classification by Courses

| Name of Course Pursued | 4th year | 3rd year | 2nd year | 1st year | Unclassified | Total |
|---|---|---|---|---|---|---|
| **First Year (Four-Year Courses)** | .... | .... | .... | 326 | .... | 326 |
| **Architecture** | 8 | 13 | 30 | .... | .... | 51 |
| **Ceramic Engineering** | 6 | 11 | 18 | .... | .... | 35 |
| **Chemical Engineering** | 20 | 25 | 31 | .... | .... | 76 |
| **Civil Engineering** | 28 | 37 | 44 | .. | .... | 109 |
| **Electrical Engineering** | 30 | 36 | 51 | .... | .... | 117 |
| **Mechanical Engineering** | 28 | 37 | 43 | .... | .... | 108 |
| **Mine Engineering** | 14 | 6 | 9 | .... | .... | 29 |
| **Special** | .... | .... | .... | .... | 6 | 6 |
| **Clayworking (Short)** | .... | .... | 2 | 3 | .... | 5 |
| **Industrial Arts (Short)** | .... | .... | 4 | 5 | .... | 9 |
| **Mining (Short)** | .... | .... | 1 | 4 | .... | 5 |
| Total | 134 | 165 | 233 | 338 | 6 | 876 |

## GRADUATES

November 1st, 1913

### Classification by Courses

| Name of Course | Degree Conferred | Number of Graduates | |
|---|---|---|---|
| Architecture | C. E. (in Arch.) | 20 | 37 |
| | B. Arch | 17 | |
| Ceramic Engineering | E. M. (in Cer.) | 13 | 91 |
| | Cr. E. | 78 | |
| Chemical Engineering | B. Sc. (in Chem.) | 44 | 81 |
| | B. Sc. (in Chem. Eng.) | 37 | |
| Civil Engineering | C. E. | | 346 |
| Electrical Engineering | M. E. in E. E. | | 358 |
| Industrial Arts | B. Sc. (I. A.) | | 6 |
| Mechanical Engineering | M. E. | | 264 |
| Mine Engineering | E. M. | | 163 |
| Advanced Degrees | M. Sc | 3 | 4 |
| | D. C. E. | 1 | |
| Total | | | 1350 |
| Less names counted twice | | | 6 |
| Net Total | | | 1344 |

# GENERAL INFORMATION

## FELLOWSHIP

The Stillman W. Robinson Fellowship in Engineering, endowed by the late Emeritus Professor of Mechanical Engineering, Stillman W. Robinson, for the encouragement of graduate research in engineering, provides five hundred dollars ($500.00) annually, and is open to graduates in Mechanical, Civil, and Electrical Engineering. Any student to whom this fellowship is awarded must devote his entire time to the work, which shall amount to at least sixteen credit hours per week, of which at least eight shall be in the line of original research or investigation. For one year's work and a satisfactory thesis, a master's degree may be given. For two year's work, and a satisfactory thesis, a doctor's degree may be given. For further information consult or address the Secretary of the College of Engineering.

## FEES

All fees must be paid at the opening of each semester as a condition of admission to classes. Registration is not complete until the incidental and laboratory fees are paid.

**Incidental Fee**—The fee for students who are residents of Ohio is fifteen dollars a semester. For non-residents, the fee is twenty dollars a semester. Students must reside in Ohio one year before they are eligible under the resident fee. Children of non-resident Alumni pay the same fee as residents of Ohio.

Former students, who do not pay this fee until third day of the first semester and the second day of the second semester, must pay one dollar additional. For each day of delay thereafter, fifty cents is added.

**Laboratory Deposit.** Students are required to pay for all materials consumed in laboratory work. To meet the cost of these materials, a deposit for each course requiring such supplies is made at the Bursar's office before the work is begun. In Chemistry the deposit is ten dollars. In other courses it varies with the amount of materials used. All laboratory supplies are sold at the General Store Room, Chemistry Hall, to students at about first cost to the University, and charged against the deposits. Any unused part of the deposits is refunded at the end of the semester.

## OTHER EXPENSES

**Locker Fee**—The gymnasium is free to all students, but those desiring to use a locker are charged a fee of two dollars a semester, which includes the rental of towels.

**Cadet Uniform**—The uniform with which the members of the regiment are required to provide themselves costs (without overcoat) about twelve dollars. It is quiet in pattern and may be worn in place of civilian dress.

New students are advised against buying second-hand uniforms unless they have been previously inspected and approved by the Commandant. Inspection has shown in many cases that second hand uniforms were unfit to wear and certainly not worth the price asked for them. All such uniforms are subject to rejection by the Commandant. Students should not arrange for uniforms until so directed by the military authorities.

**Changes in Subjects or Schedule**—After the first five days of each semester changes in subjects or schedule, if made at the request of the student, shall be made only upon the payment of a fee of $1.00 for each change.

**Graduation Fee**—A fee of five dollars, to cover expense of graduation and diploma, is required of each person receiving one of the ordinary degrees from the University, and this fee must be paid before the last Friday preceding Commencement. A like fee of ten dollars is charged each person receiving one of the higher graduate degrees.

**Rooms and Board**—Furnished rooms accommodating two students, can be rented at one dollar to one dollar and a half per week for each student. Board at the restaurants and boarding clubs near the University costs from three dollars and twenty five cents to three dollars and fifty cents per week. The Ohio Union Commons offers board to men at reasonable rates. Board, with furnished rooms, can be obtained in private families at rates varying around six dollars per week.

**The Ohio Union**—A fee of one dollar a semester is paid by all male students at registration. This entitles the student to all privileges of the Union, consistent with the constitution and house rules governing it.

**Text Books**—Students should not purchase text-books until they are advised by the instructors of their respective classes.

## EXPENSES PER YEAR

One of the most perplexing questions that confronts a prospective student is what the course is going to cost him a year.

In order to furnish information, we have listed below an estimate of the average payments required by the University for the freshman year in the College of Engineering, and have estimated the cost for room and boarding at a safe price. These two items are sometimes reduced slightly where two students occupy the same room and where boarding clubs are economically managed. Fees to the University are paid one-half at the beginning of each semester.

| | |
|---|---|
| Incidental fee | $ 30 00 |
| Ohio Union | 2 00 |
| Gymnasium locker | 4 00 |
| Deposits to cover laboratory materials and breakage | 20 00 |
| Drawing instruments and supplies | 20 00 |
| Uniform | 12 00 |
| Books | 15 00 |
| Board—36 weeks at $3.50 per week | 126 00 |
| Room rent, at $8.00 per month | 72 00 |
| General expenses | 100 00 |
| | $401 00 |

The item of general expenses is always subject to the personal habits of the individual, and varies according to the degree of economy exercised.

**Note**—In order to meet all the necessary expenses of registration, books, uniform, and other expenditures incident to securing a room and board, a student should come prepared to expend from $65.00 to $75.00 during the first ten days of a semester. After that period his board and room rent will constitute the major part of his expenses.

## SELF SUPPORT

There is a considerable amount of work upon the farm and in the shops and laboratories of the University which may be assigned to students on application. Preference is given to those studying Agriculture or one of the Engineering courses. *The University cannot promise work to all applicants.* Many students find work in private families, in offices, and in various occupations, by means of which they defray at least a portion of their expenses. A person of ability and energy, who is master of a trade or who can do good work of any kind, can generally find remunerative employment. It has seldom been found that any student of ordinary energy and industry was obliged to leave the University because of lack of money for necessary expenses, after having been sixty days on the ground—or long enough to inform himself as to the opportunities for securing employment. As an accommodation, the executive office co-operates as far as possible in this matter. The Y. M. C. A. offers its services in helping young men to secure employment. Very much depends, however, on the individual's power of initiative. Students should not come to the University expecting others to find places for them. They should report to the executive office from time to time as to their needs and their work. This will enable the authorities to be more helpful than otherwise would be possible.

A student devoting much of his time to earning his way will be unable to carry successfully the full amount of collegiate work. Such students should apply for the privilege of carrying reduced work. This, of course, means that the time required to obtain a degree will be extended to five or more years, according to the amount of work successfully carried each year.

Self-support does not excuse students from cadet service. Prospective students are advised to make note of this fact before deciding to enter the University. Special students, so-called, are also required to take the cadet service.

**Consultation.** For consultation in regard to their status as members of the College of Engineering, or for the filing of petitions, changes of the course, of class cards, adjustment of schedules and similar needs, students will apply to the Secretary, Mines Building, Room 131, from 10 to 11 a. m.

## Y. M. C. A.

The Young Men's Christian Association has come to occupy a prominent place in University life. It has a membership of about six hundred men, and is affiliated with the World's Student Christian Federation.

Religious meetings are held for men on Wednesday evening; there are also frequent meetings for the promotion of social intercourse and good fellowship. Courses in systematic Bible study and in modern missions are offered. A most helpful feature of the work is that in the interest of new students at the opening of the school year. Desirable rooms and boarding places are found and listed for reference at the Association office. Representatives of the Association meet the trains, assist students in finding satisfactory locations, and endeavor in every way to make them feel at home. The Employment Bureau helps to find work.

A copy of the Students' Handbook, giving information about Columbus, the University, and the various college organizations and activities, will be sent free to prospective students. For this hand book or for further information, address the General Secretary of Y. M. C. A., University Campus, Columbus, Ohio.

## UNIVERSITY PASTORS

The Methodist Episcopal and the Presbyterian Churches have stationed pastors at the University to serve students of their respective churches and others who may desire it. The local pastors of other denominations also take a sympathetic interest in the students who attend their churches.

The Ohio State University Bulletin is issued at least twenty times during the year; monthly in July, August, September, and June, and biweekly in October, November, December, January, February, March, April, and May.

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